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             INVESTIGATION OF VELOCITY FIELD ABOUT A TWO DIMENSIONAL PLEXIGL--ETC(U)
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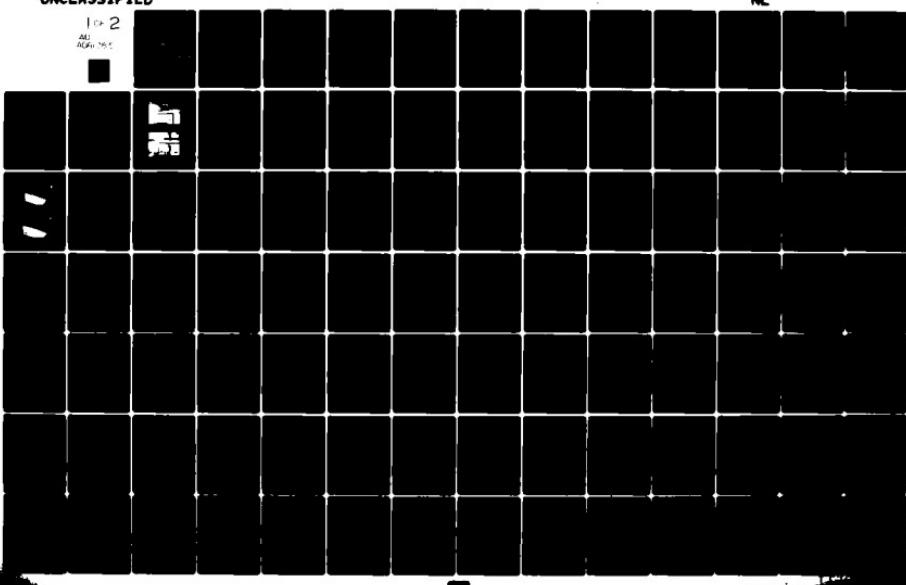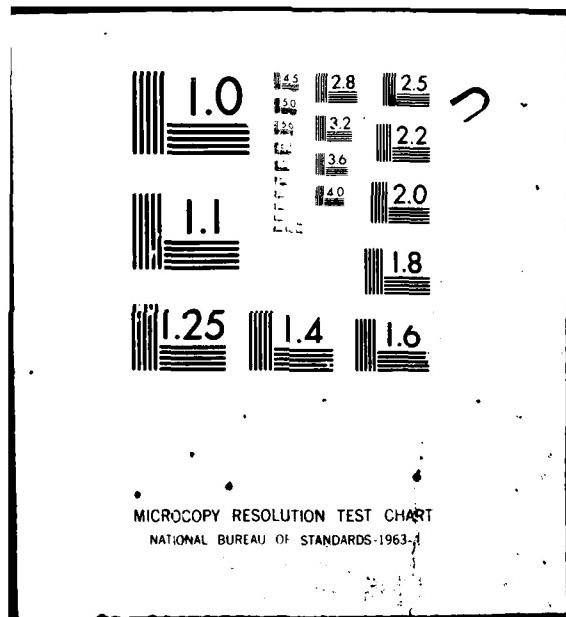
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INVESTIGATION OF VELOCITY FIELD ABOUT

A TWO DIMENSIONAL PLEXIGLASS OGIVAL

FOIL USING THE LASER DOPLER ANEMOMETER

by

GARY J. TETTELBACH

Submitted to the Department of Ocean Engineering on May 12,
1978, in partial fulfillment of the requirements for the
degrees of Ocean Engineer and Master of Science in Naval
Architecture and Marine Engineering.

ABSTRACT

Until recently measuring the velocity of a fluid
required the insertion of some instrument into the flow which
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Thesis Supervisor: Professor Justin E. Kerwin
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Gary J. Tettelbach, USN

B.S.(NA) U.S. Naval Academy
(1970)

Master's thesis

Submitted in partial fulfillment
of the requirements for the degree of

OCEAN ENGINEER

and for the degree of

MASTER OF SCIENCE IN NAVAL ARCHITECTURE

AND MARINE ENGINEERING

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 78

Signature of Author_____
Department of Ocean Engineering
June, 1978

Certified by_____
Thesis Supervisor

Accepted by_____
Chairman, Department Committee
on Graduate Students

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ACKNOWLEDGEMENTS

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I. INTRODUCTION

A variable speed water tunnel in a common laboratory for conducting hydrodynamic experiments involving Reynolds Number scaling. Until recently, however, there has been no reliable method in water tunnels of measuring either point velocities or pressures in a flow without disturbing the flow. Hot wire anemometers or pitot tubes require the insertion of an instrument into the flow and can cause a disturbance of the flow. The recent development of the laser dopler anemometer, LDA, has led to a method of obtaining point velocities without the insertion of any instrument into the flow which could alter the characteristics of the flow. The detailed operation and theory of the LDA will be covered in another section so let it suffice to say now that by having two monochromatic light beams, one of which has been shifted in frequency, intersect the velocity of the water at the point of intersection can be measured by collecting the scattered light.

The LDA at MIT is only capable of collecting the light scattered in the direction in which the beams are aimed. This means that the light must be able to pass completely through the water tunnel when attempting measurements. There is no problem with this if the only measurements needed are upstream or downstream of the model in the tunnel because the viewing ports or windows are transparent plexiglass. Measurements cannot be taken around a model which is opaque, however.

The purpose of this thesis is to demonstrate that by using a transparent model; in this case a two dimensional, plexiglass, ogival section foil; the entire velocity field around the model can be obtained. The problems associated with this involve both the optical characteristics of the model and the intensity of the scattered light when it has passed through the model. The positioning of the instrumentation that receives the scattered light is critical and resolution of the optical effect of the model on the scattered light becomes difficult. Any imperfections in the model also tend to diminish the intensity of light which eventually reaches the receiving optics. The results contained within this thesis are not necessarily intended to be extraordinarily revealing in hydrodynamic significance but rather are intended to describe and verify a new technique in collecting detailed accurate velocity data around a transparent model in the variable speed water tunnel using a laser dopler anemometer.

II. EXPERIMENTAL SET UP

This experiment was conducted in the variable speed water tunnel at MIT. The tunnel is a recirculating type tunnel with a test section which is basically a rectangle twenty inches high, twenty inches wide and with a region of undistrubed parallel flow approximately four feet in length. The model was held in place using the rudder and keel dynamometer on the top and just a sealed shaft through the bottom window. This is the normal method for testing two dimensional foils at the MIT facility. No splitter plate was used in order to allow maximum span of the foil which would reduce any end or wall effects. The foil was aligned in the tunnel to zero angle of attack by measuring the distance from the wall. The telescope atop the dynamometer was then zeroed and used to adjust the angle of attack thereafter.

Because of the lens effect of the foil, velocity measurements were only taken on the transmitter side of the foil. The lens effect changed the crossing angle of the beams which made the calibration of volts to feet per second and the position of the measuring volume unknown. To obtain measurements on both sides of the foil, the foil was flipped end for end.

The actual construction of the foil was done by Bill Shepherd for a 13.04 project and donated to the author. The method of construction was to take a rectangular piece of plexiglass and first use a milling machine and large rotating

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table bed to get a circular arc. The second step was to polish the foil until transparent with progressively finer sandpaper and polishing compound. The difficult areas were the leading and trailing edges because of their fineness. Keeping the circular arc and yet getting rid of all defects and scratches requires more sophisticated equipment than was available. However, the foil is a masterpiece of hand crafts-manship and far better than the author could have done personally. The final foil dimensions are shown in figure 1.

The laser itself was resting on a base capable of move-ment in two degrees of freedom. The one degree of freedom in which the laser could not move was a chordwise movement. This was a very time consuming restriction because to move from station to station along the chord both the transmitting and receiving optics had to be manually picked up, moved, and realigned again. The base on which the laser rested never had to be moved because large enough plywood platforms were installed to allow enough laser movement to position the laser at all stations on the chord. Figure 2 shows the receiving optics, test section and dynomometer with telescope. Testimony to the quality of the foil is that it was in the test section when the picture was taken. Figure 3 shows the transmitting optics, vertical adjustment wheel and the sta-tion marking taped on the outside of the test section window.

19.75"

9.802"

.98"

R / 12.745"
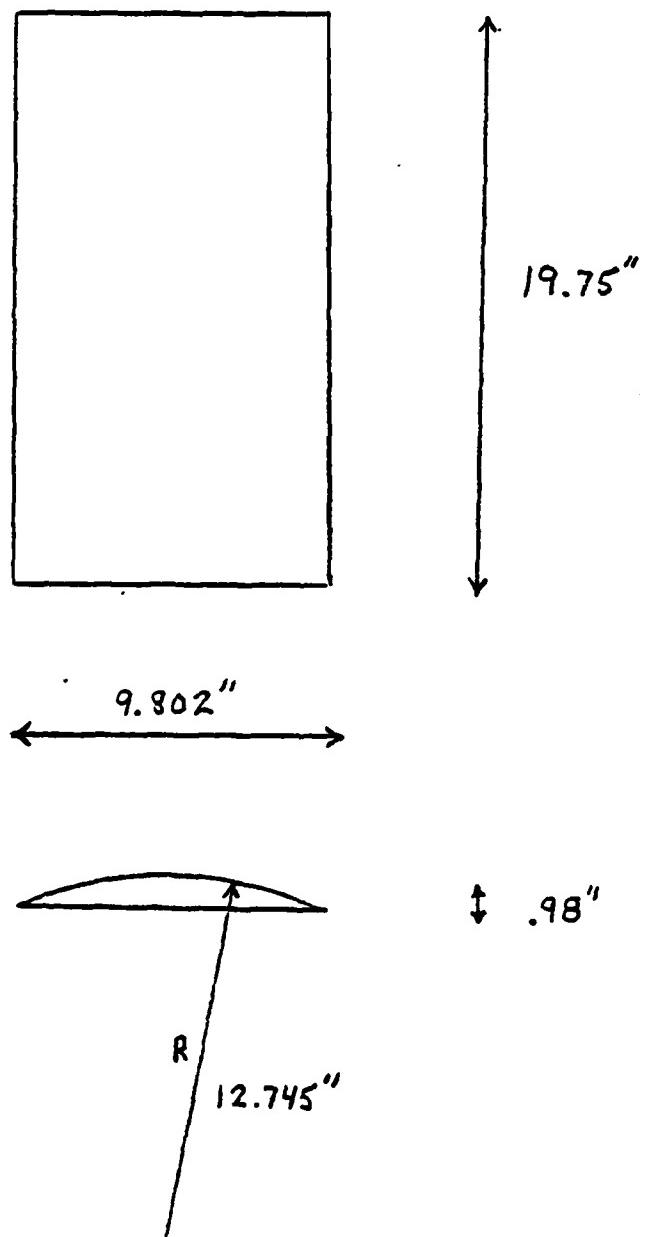
FIGURE 1 - Foil Dimensions
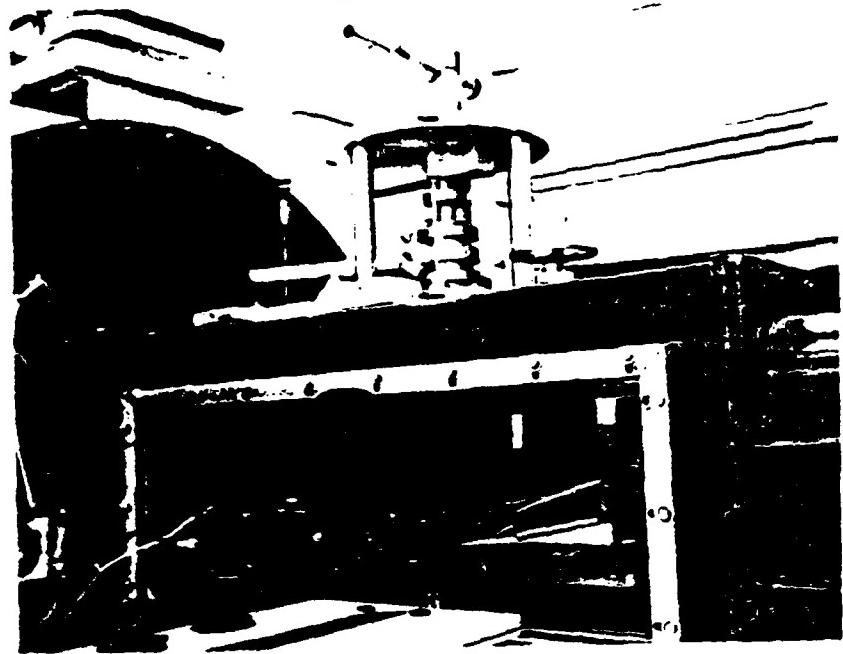
FIGURE 2 - Receiving Optics, Test Section, Dynomometer
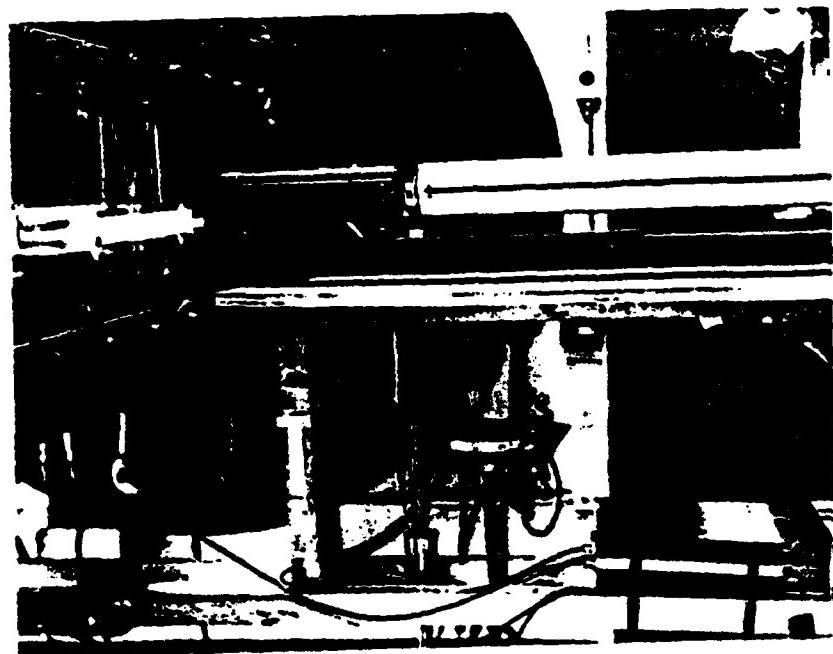
FIGURE 3 - Transmitting Optics, Vertical Adjustment, Station
          Spacing

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To determine the precise position of the measuring volume, the chordwise position of the stations had to be determined. This was done by using the laser to mark on a tape placed on the outside window of the test section the exact position of the leading and trailing edges. This tape was then marked off in cosine spacing and left taped to the window for the duration of that test. The chordwise positioning of the laser was the least precise measurement of the experiment.

The rest of the electronics including the signal processor and tracker for the laser, the voltage to frequency converter, the time averagers for the impeller RPM and converter, and the oscilloscope were all mounted on a table or moveable stand. These locations are strictly a matter of personal preference and of no relevance to the experiment.

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III.1   LASER THEORY

The author had difficulty when beginning his research finding a reference which was either complete, concise, or clear on the actual theory of laser dopler anemometer operation. In the following section is a brief overview of laser theory, but for anyone interested in specifics Peter Min's doctoral thesis, "Numerical and Experimental Methods for the Prediction of Field Point Velocities Around Propellor Blades" is to be completed in May 1978 and contains the best reference the author has been able to find.

The laser dopler anemometer is comprised of three major groups, the transmitting optics, the receiving optics, and the signal processing electronics. The transmitting optics produces a single monochromatic beam which is then split by a prism into two beams. One of these beams then passes through the Bragg cell which shifts the frequency of the light by a piezeo-electric process. This shift can be varied from .01 to 20 megahertz depending on the expected water velocity fluctuations, and allows the electronics to recognize negative velocities. The two beams are then focused by a lens of known focal length. In this experiment the focal length was 309 mm. A longer focal length is necessary if data is to be taken the complete width of the tunnel but this lens was adequate because data was only taken on one-half of the tunnel. The point of intersection of the beams is the measuring volume,

which is approximately .227 mm in diameter. In the measuring
volume the intersection of the light beams sets up a series of
frequency fringes. As a particle in the water passes through
these fringes light is scattered at a frequency proportional
to the speed of the particle. The light is scattered in all
directions but the maximum intensity is in the direction of
the laser beams and equidistant from each beam. The velocity
measured is the velocity in the plane of the two beams and
perpendicular to the line that bisects the two beams.

The receiving optics is placed on the same structure as
the transmitting optics on the opposite side of the tunnel
and aligned with it so as to collect the maximum intensity
of scattered light. There is a lens which focuses the light
on a photo-dectector. This photo-dectector produces a
voltage proportional to the frequency of the scattered light.

The electronics takes the signal from the photo-dectector
processes it through a series of filters, and tracks it. The
tracker produces a visual display of the voltage over each
second. With the electronics the number of particles
counted per second and the filtering can all be adjusted to
the conditions present. To average the voltage over ten
seconds the voltage was converted to frequency and averaged
over ten seconds.

III.2   LASER DOPLER ANEMOMETER TECHNIQUES

This section is intended to be a documentary on the author's learning process while conducting this experiment. Hopefully, by reading this anyone who attempts a similar experiment can avoid many frustrations and pitfalls.

To operate a laser dopler anemometer takes patience and experience. There is an art involved and practice is the best way to acquire expertise. Probably the most intelligent move the author made in the collection of data was to start testing in the first week of November of 1977. This one week was not very productive in the way of data taking but extremely important in learning how to operate the laser. Between this week and the next opportunity the author had to test in the water tunnel there was time to evaluate methods and procedures and study more on the aspects of operation that needed improvement. The data collected in February of 1978 not only has a higher confidence level it also was taken much faster and more easily.

The first step in the learning process was in determining the position of the measuring volume. The method of determining chordwise position was improved by two simple procedures. First, the author learned that by unscrewing two screws the laser beams could be aligned vertically. This greatly aided in determining the exact position of the leading and trailing edges. Secondly, there is a smoked glass filter

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which decreases the intensity of the laser beams. By decreas-
ing their intensity aligning was easier and the positioning
at each station more accurate because the light could be made
to a much finer dot on the marking tape.

An order of magnitude improvement in accuracy was made in
determining the distance of the measuring volume from the foil
surface between November and February. For the initial tests
the distance of the laser lens from the tunnel window was
measured and measuring volume position was in terms of a
distance from the tunnel wall. The problem was determining
the exact position of the foil in terms of distance from the
wall. The solution was to place the measuring volume just on
the edge of the foil visually and then record the laser
position by reading the pointer on the movable base of the
laser. The other data points were determined by a simple
linear relationship of laser movement to measuring volume
movement. The only problem with this method was at stations
one and nine. There the foil was so thin it became difficult
to determine on which side of the foil the measuring volume
was.

The determination of free stream velocity was also
improved between test periods. The procedure of reading the
manometer for each data point was not only tedious to record
but tedious to convert to speed later. By taking and averaging
the impeller RPM over ten seconds and taking a manometer
reading over that same ten seconds a linear relationship

between RPM and free stream velocity was developed. By averaging twenty-five of these readings a coefficient in terms of velocity per RPM was developed. A new coefficient had to be determined for each angle of attack, however, because the blockage of the model changed for each case. Another convenience of this was that the output of the laser tracker was averaged over the same ten second period.

To overcome the problem of the optical effect of foil acting like a lens was of great concern at first but really turned out to be a minor problem. After a brief study of optics, the author decided calculating the position of the receiving optics would be futile at best. The best method turned out to be visual adjustment. First two pieces of tape were placed on the window on the receiving optics side to block the two laser beams from exiting the tunnel test section. This was important for safety to prevent any eye damage while visually focusing. The receiving optics was then manually moved on the plywood base until the focusing pattern was symetrical and at maximum brightness. As a result of the focusing effect of the foil the receiving optics were only perpendicular to the window at zero degrees angle of attack and at station five. Maneuvering the receiving optics while looking through the eyepiece was awkward and certainly not precise but it was effective. At the stations near the leading and trailing edges re-focusing was required about every other data point and this

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was tedious, but there was no better alternative. To align the receiving optics exactly so as not to require such frequent refocusing would have taken exorbitant amounts of time if possible at all.

In November it was obvious that there were defects in the foil, particularly near the leading and trailing edge. By moving just fractions of an inch spanwise, reception of the signal improved greatly because the light was not being dispersed by a nick or imperfection in milling. This vertical movement was also used to avoid window scratches. Another method of improving reception, dealing with the model and windows was to ensure they were clean. Wiping them both with soft tissues and alcohol has a much more dramatic effect than it would appear.

Of the three areas of adjustment; the foil, the water, and the laser; the water could be least affected or adjusted. If the water is very cold, below sixty degrees fahrenheit, readings are very difficult to obtain. The number and type of particles also is important. There are several types of additives on the market today which can be added to improve water characteristics but they are costly and do not stay in the system. Ordinarily there were enough particles in the water for adequate laser operation, but if more particles were needed the addition of four teaspoonsfull of "Coffeemate" was helpful. These particles dispersed evenly in the tunnel

and appeared to be the correct size to improve operation. The question of when should particles be added is best answered by experience. If all else seems to be functioning properly but the signal will not track the addition of particles can't hurt.

Most of what appears to be "tricks of the trade" in obtaining meaningful data are involved with adjustment of the laser itself. The references mentioned in section 3.1 are very helpful in understanding how the laser operates and how to obtain a signal when conditions are ideal. In the case of this experiment, however, conditions were seldom even close to ideal. Therefore, several ways to improve the signal characteristics or detect weak signals were devised. The first step was to do the easiest station, station five, first to ascertain that all of the equipment did indeed operate and the laser was aligned. Once the laser beams were aligned they did not abruptly go out of alignment. The deterioration was gradual and if suddenly one data point would not track the chances were very slim that it was due to misalignment of the laser if the previous data point had a good signal. The quality of the signal often-times could be improved by blocking out unwanted beams. The beam that was shifted in frequency in the Bragg cell came out of the transmitting optics surrounded by three extraneous beams of weaker intensity. These beams often

would scatter light when they impinged on the foil and
increase the noise in the received signal enough to make
the signal indecipherable. By taking a small piece of
black tape and carefully placing it on the tunnel window
these beams could be removed. To insure the correct beam
was still entering the water the Bragg cell was turned off.
This eliminated the frequency shift and left only one beam,
the correct one. Once it was determined the correct beam
was not blocked the Bragg cell was turned on again.

The laser dopler anemometer will always produce a
reading of some kind. To master the LDA is to know when
that reading is the correct reading for the water velocity
in the measuring volume. The most helpful instrument in
doing this was the oscilloscope. Unfortunately, the author
did not use the scope until test forty-four out of sixty-nine
tests. But in terms of accuracy of data this was a major
breakthrough. What the oscilloscope did was visually display
the signal coming from the photomultiplier and allowed con-
firmation that it was indeed the true signal. It could,
of course, display more but the key to determining good
data from eroneous noise was looking at the raw signal before
it entered the signal processer. Sometimes this was more
difficult than others. If the signal was very weak and there
was very little noise, a magnificent looking signal showed
on the scope. This was the frequency shifter dominating the

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signal. Whatever megahertz shift was set on the frequency
shifter showed up on the oscilloscope looking very much like
the true signal. An easy way to discern this was to vary
the water speed in the tunnel. The wave length of the raw
signal was proportional to the speed of the water. If the
wave length increased as the water speed decreased, the true
signal was being received. If the wave length remained
constant, the signal was actually the frequency shifter.

When the signal was very weak coming from the photo-
multiplier two things helped to improve its visibility.
First, if the signal went strictly to the oscilloscope the
power was at a maximum. It was much more covenient to use
a T connection and have the signal go to both the signal
processer and the scope but this reduced the power of the
signal and often made it too weak to discern. When even
this was not enough, a second alternative was to have the
signal go through the signal processer and display the
amplified input on the oscilloscope. This was only used when
the signal was too weak by itself and the confidence in this
signal was much lower than the raw signal.

The oscilloscope could in no way have replaced the
optical focusing procedure, but it did assist. After the
visual pattern was focused and centered and the photo-
multiplier put in place, fine adjustments in centering
could be made while watching the signal on the scope. The

best way to go about this was to visually focus using the large aperture mask. This gave a more clearly defined pattern to focus. Before replacing the photomultiplier, the small aperture mask was placed on the receiving optics to reduce the noise and make the signal clearer. Then the centering set screws were adjusted while watching the raw signal on the oscilloscope.

At seven of the sixty-six stations there arose a problem which the author could never resolve. Each of these cases occurred near the leading or trailing edge but most dramatically near the trailing edge. At particular distances from the foil a beam would impinge on the very tip of either the leading or trailing and in essence spray light directly into the focusing optics. This not only made enough noise to drown the signal but made visual focusing hazardous at best. Figures 4 and 5 show this phenomenon. The author believes this was caused by the leading and trailing edges being the least perfect in curvature and thus causing strange optical effects. Vertical movement made no difference, however, so this theory is suspect. The problem was more acute at the trailing edge because of the multiple beams coming from the beam which went through the frequency shifter. These beams came from the upstream side of the laser transmitter, crossed the other beam and then impinged on the foil downstream of the other beam. This meant that the trailing edge had a greater range in which a beam could hit the edge and scatter light into the receiving optics.

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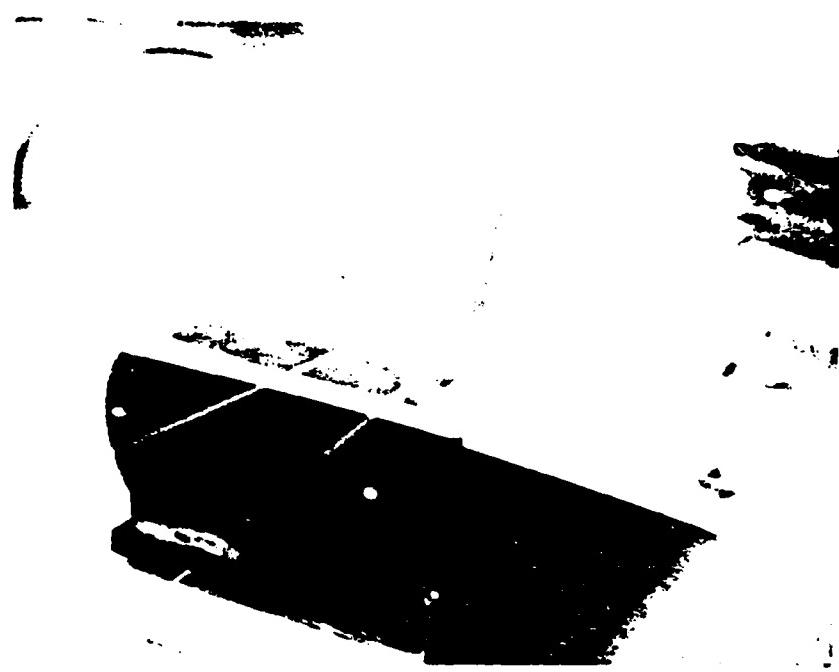
FIGURE 4 - Trailing Edge Scattering
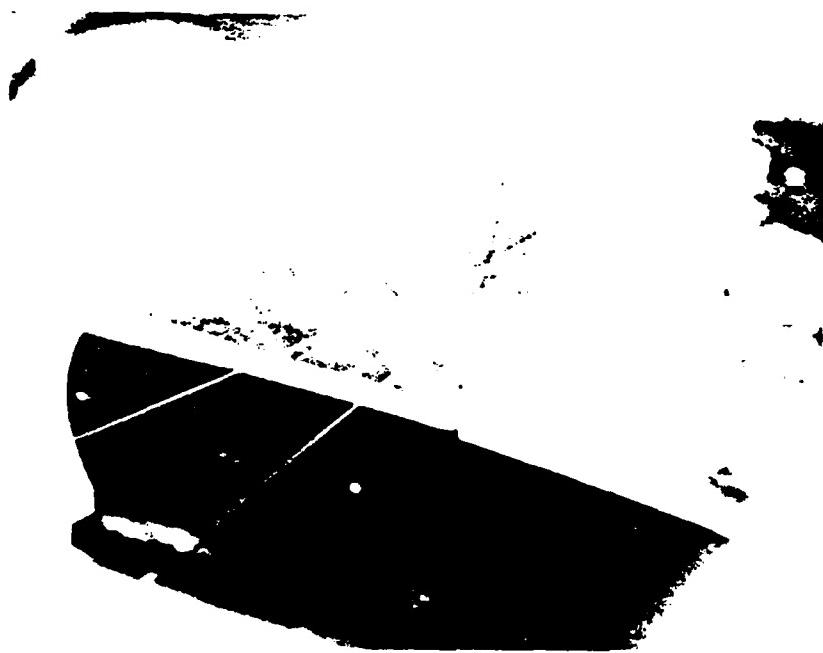
FIGURE 5 - Trailing Edge Scattering

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IV. DISCUSSION

The reason for picking an ogival shaped foil was to facili-
tate the manufacture of the foil and the theoretical calculations.
By using a Karman-Trefftz transformation the conformal mapping of
a uniform flow around a circle to a uniform flow around the foil
shape was realtively easy. A computer program entitled Karman
(Treftz) developed by John Hammond for Professor Kerwin made
the process of calculating pressure coefficients very easy.
The parameters used were circle center coordinates of x = 0.0,
y = .105098 and λ = 1.8743593. Figures 6 through 10 show the
pressure distributions calculated. The actual data was
initially plotted into the velocity profiles shown in figures
11 through 13. The points just outside the boundary layer
were determined from these plots and used to calculate the
pressure coefficient, C_p, which was defined as

$$C_p = 1 - (U_n)^2$$

where U_n is the nondimensional velocity. Determining where
the boundary layer ended was not very distinct at some
stations but a best visual estimate was used. The plots of
the experimental pressure coefficients are shown in figures
14 through 16.

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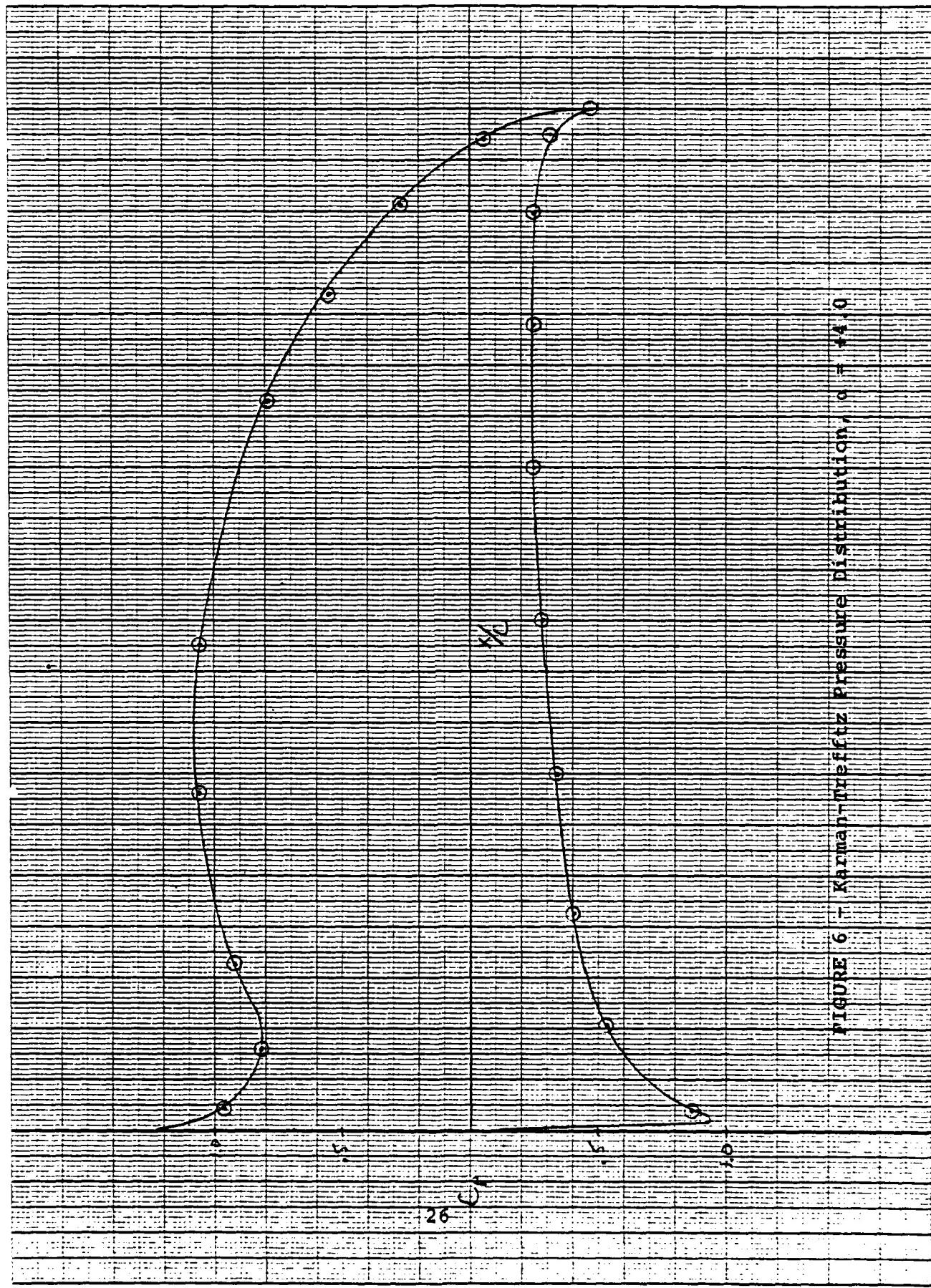
FIGURE 6. - Karman-Trefftz Pressure Distribution, $\alpha = +4.0$
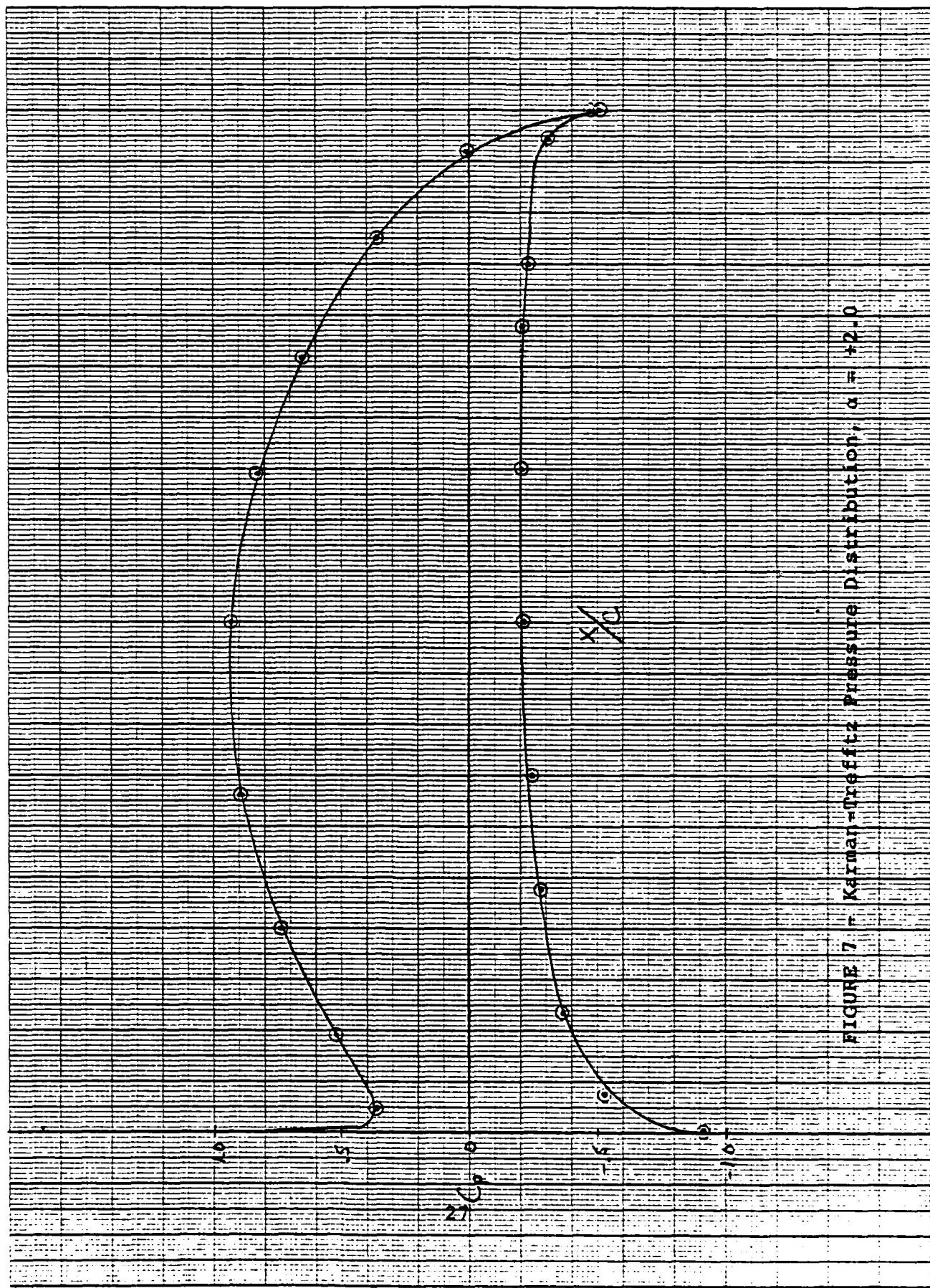
461510

FIGURE 7 - Karman-Trefftz Pressure Distribution, $\alpha = +2.0$
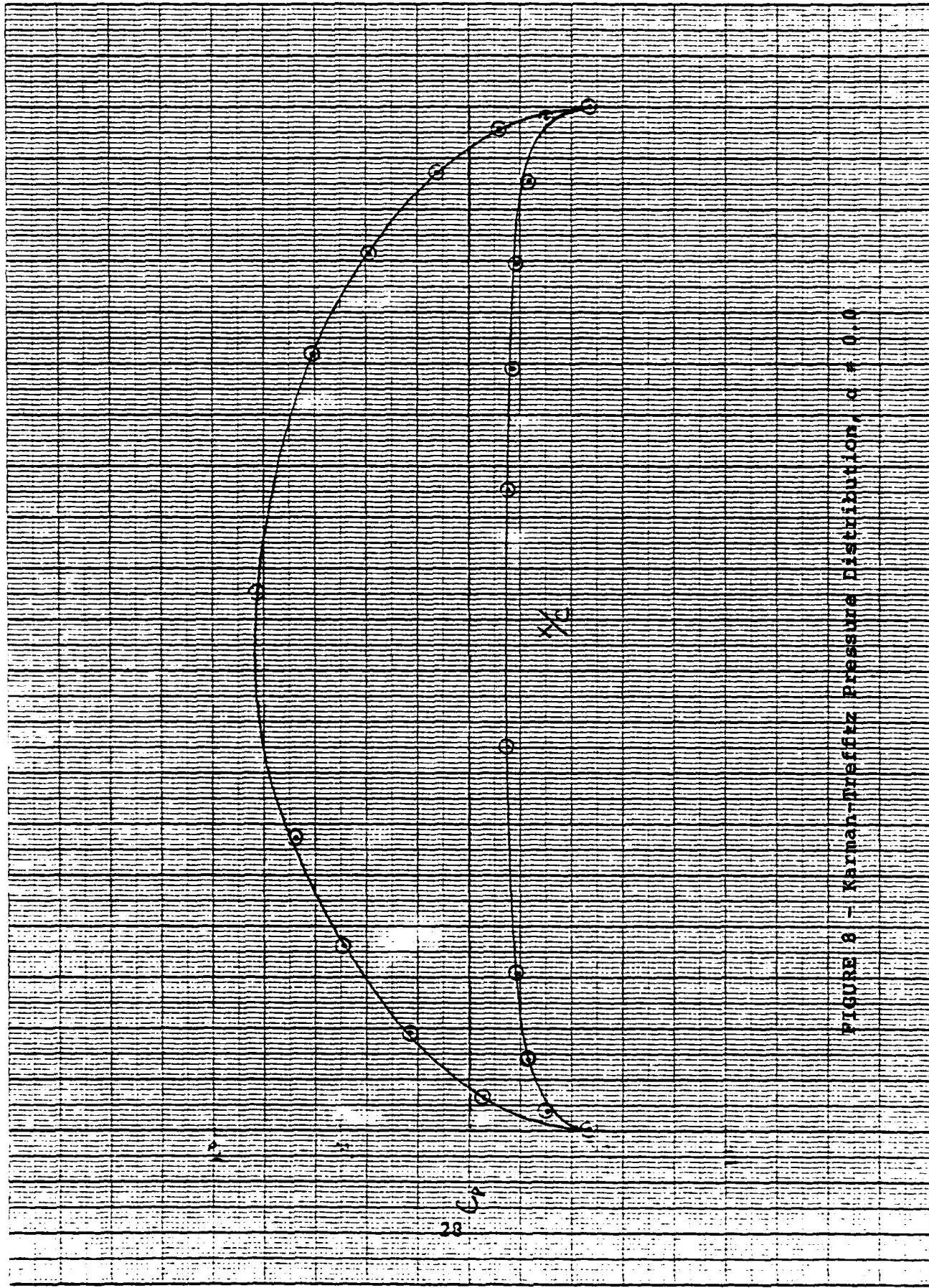
FIGURE 8 – Karman-Trefftz Pressure Distribution $\alpha = 0.0$
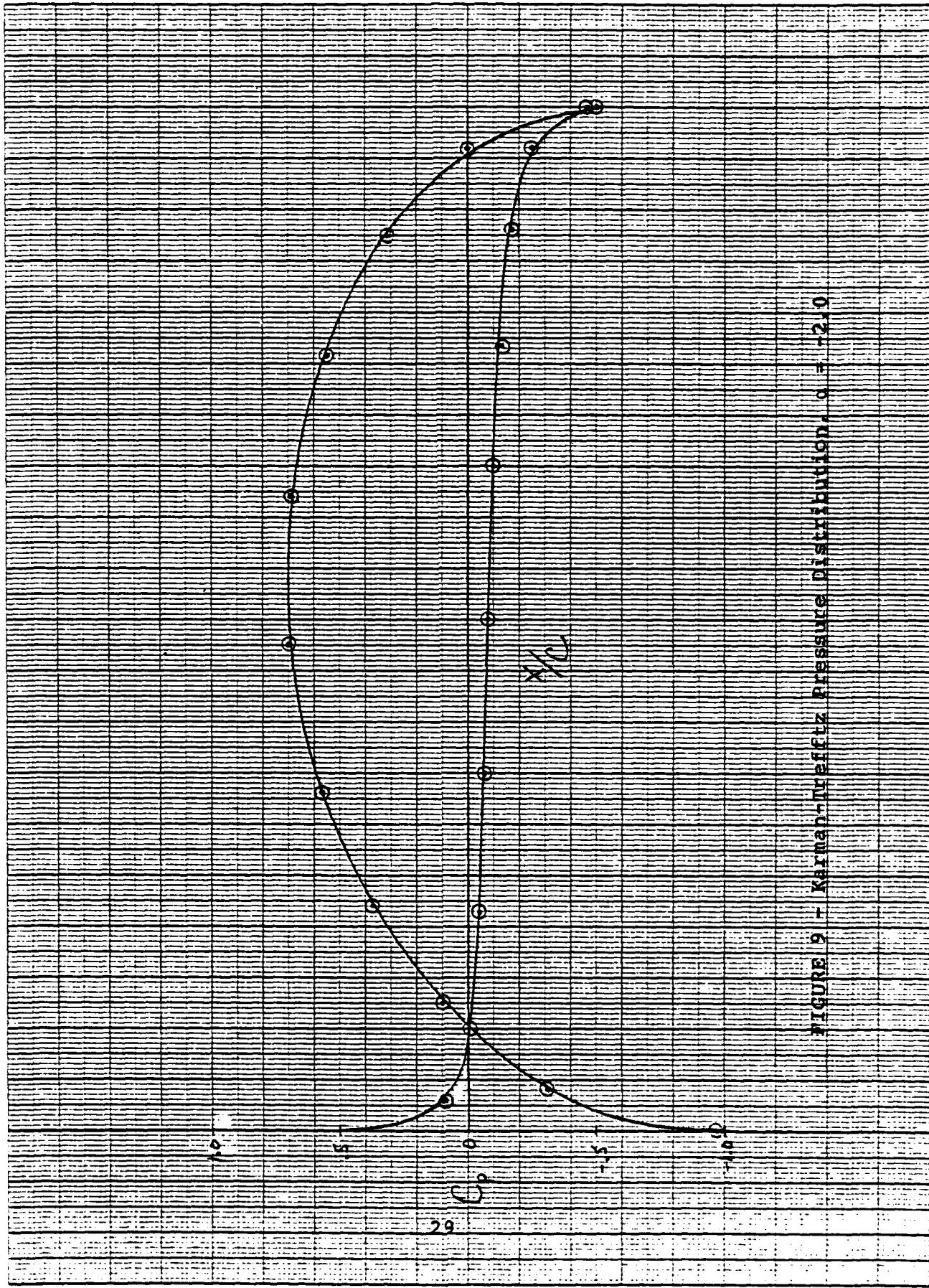
FIGURE 9 — Karman-Trefftz Pressure Distribution, $\alpha = -2.0$
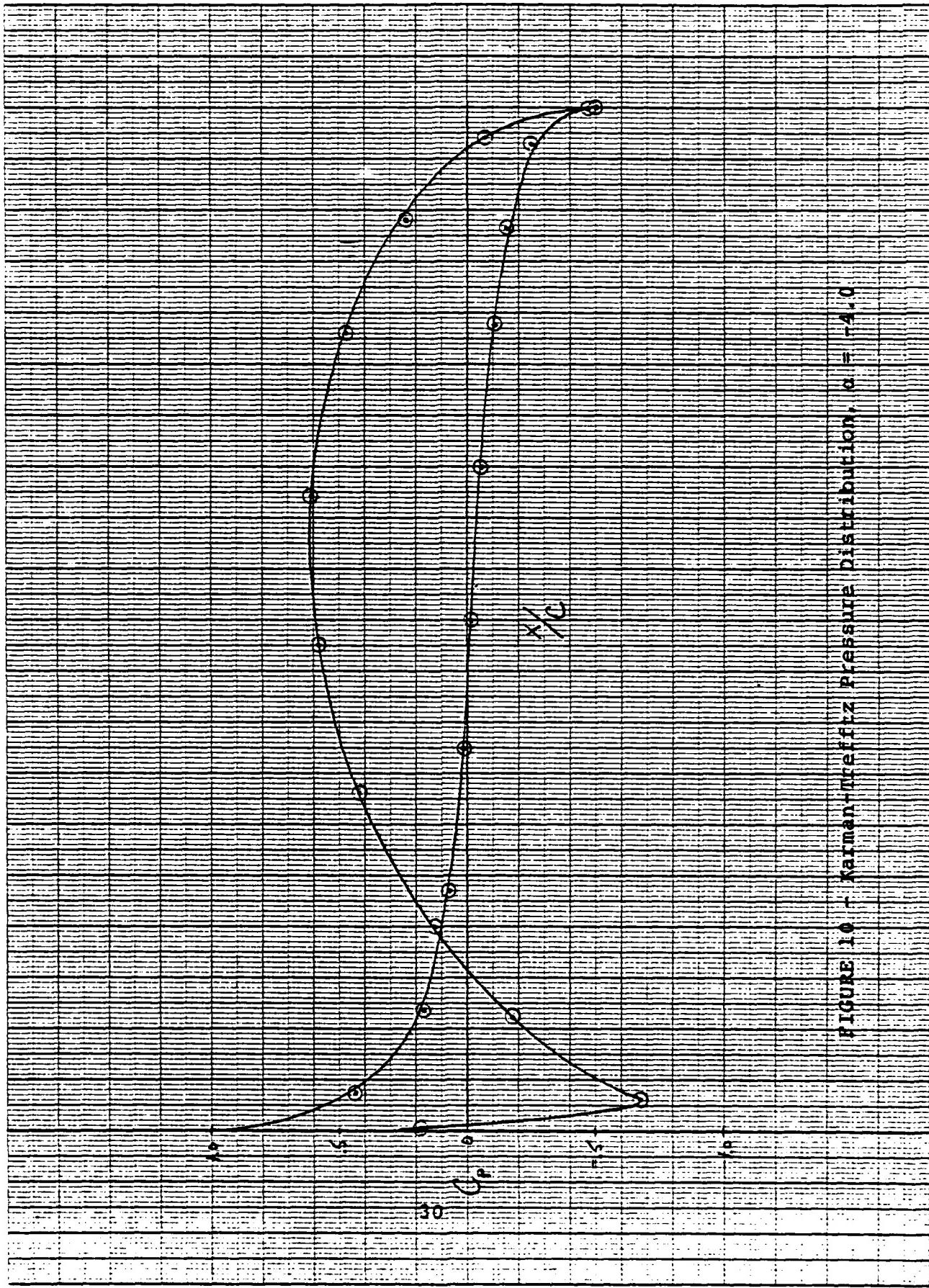
461510

FIGURE 10 - Karman-Trefftz Pressure Distribution, $\alpha = -4.0$
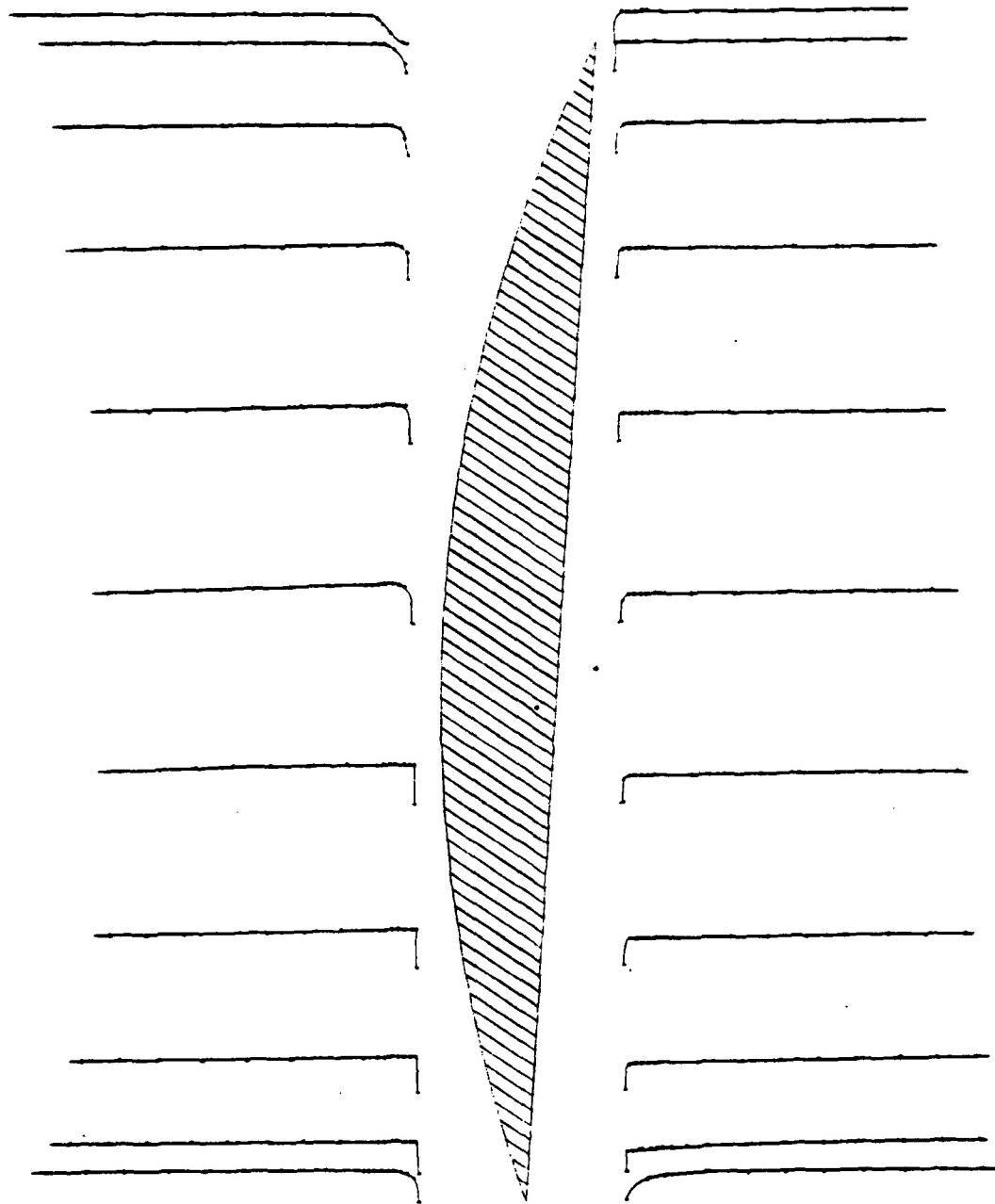
FIGURE 11 - Velocity Profiles, α = +4.0

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FIGURE 12 - Velocity Profiles, $\alpha = 0.0$
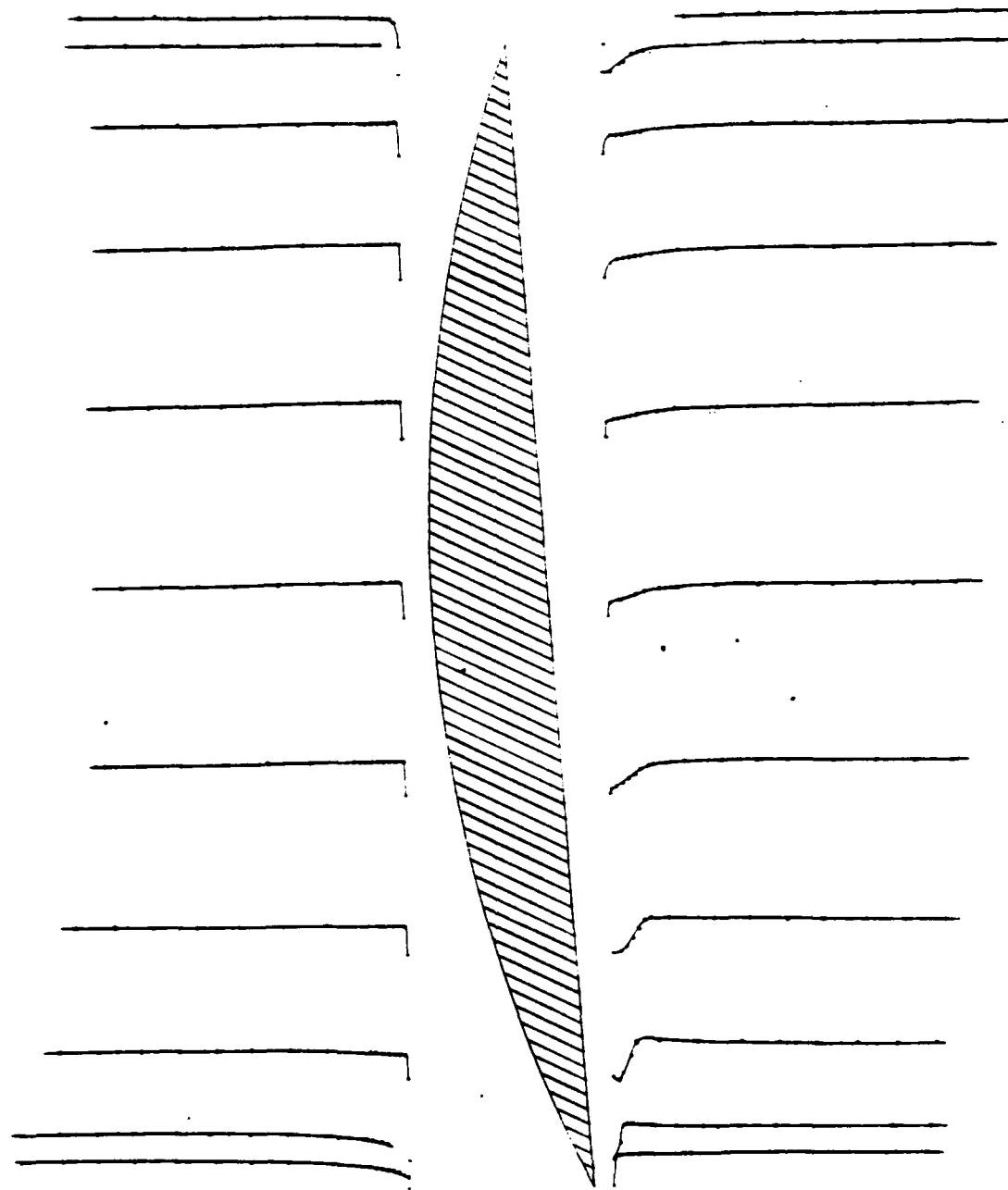
FIGURE 13 - Velocity Profiles, $\alpha = -4.0$

x/c

C_p

FIGURE 14 — Experiment Pressure Distribution, $\alpha = +4.0$
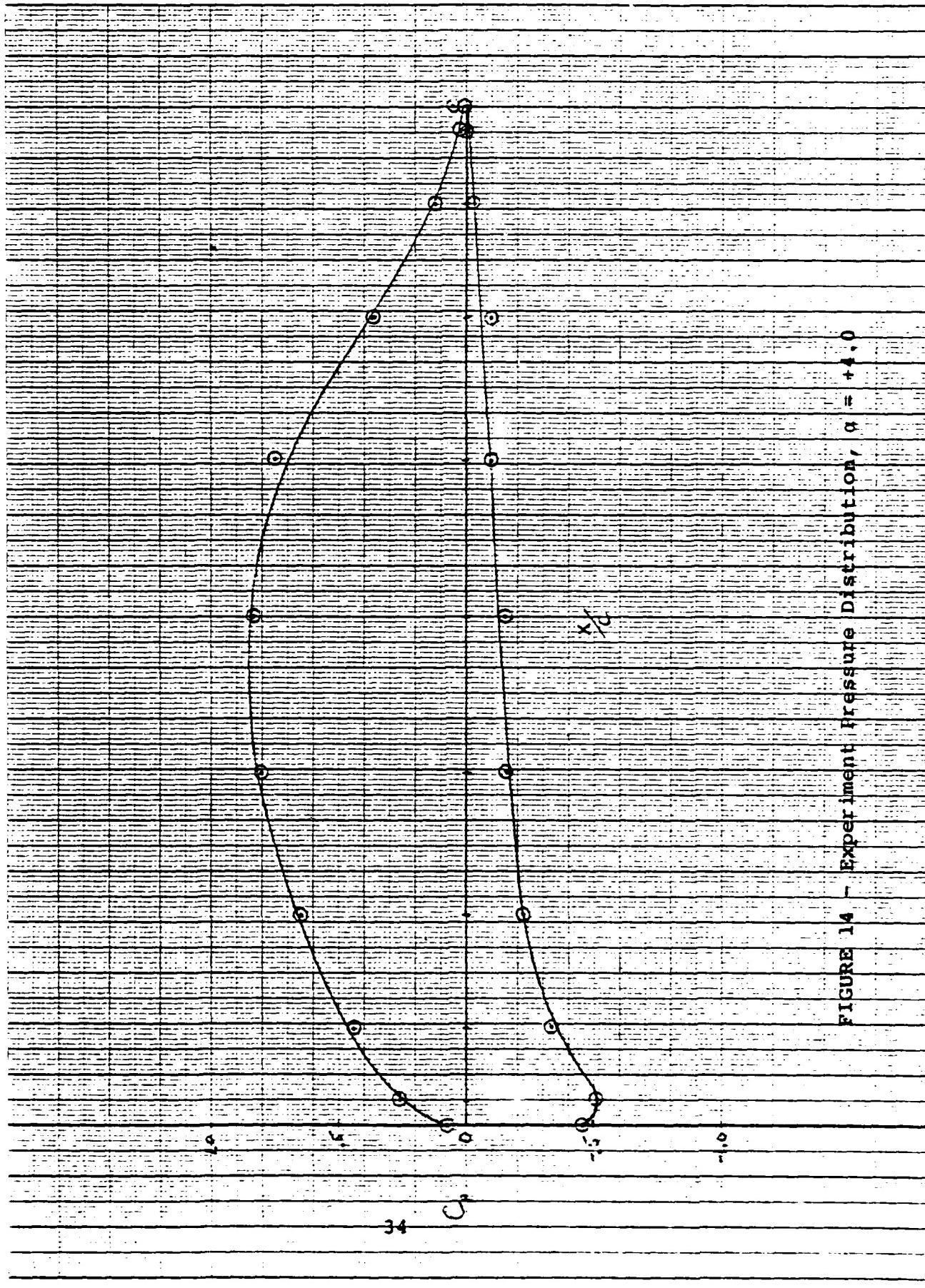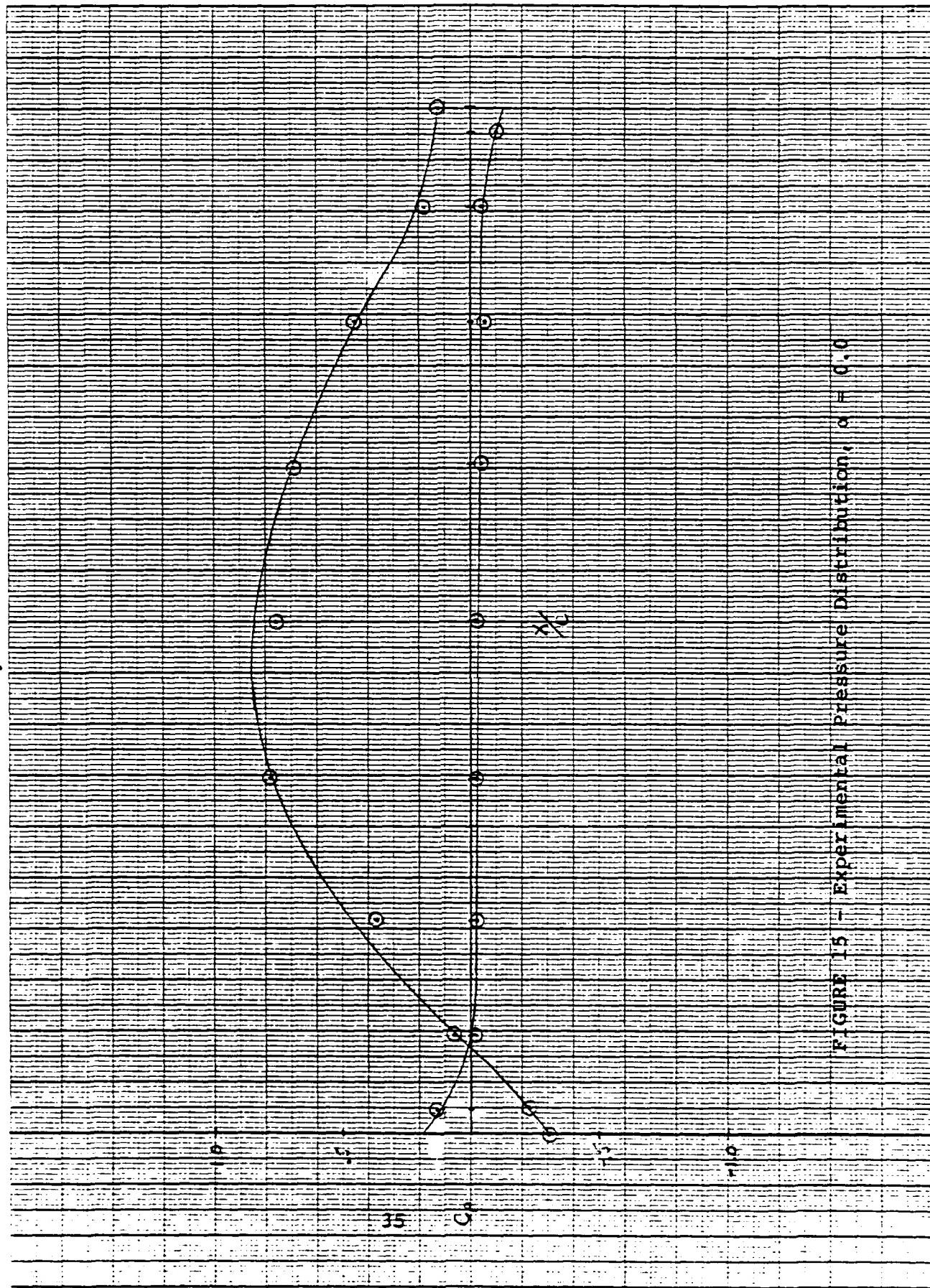
FIGURE 15 – Experimental Pressure Distribution, α = 0.0

FIGURE 16 - Experimental Pressure Distribution, $\alpha = -4.0$
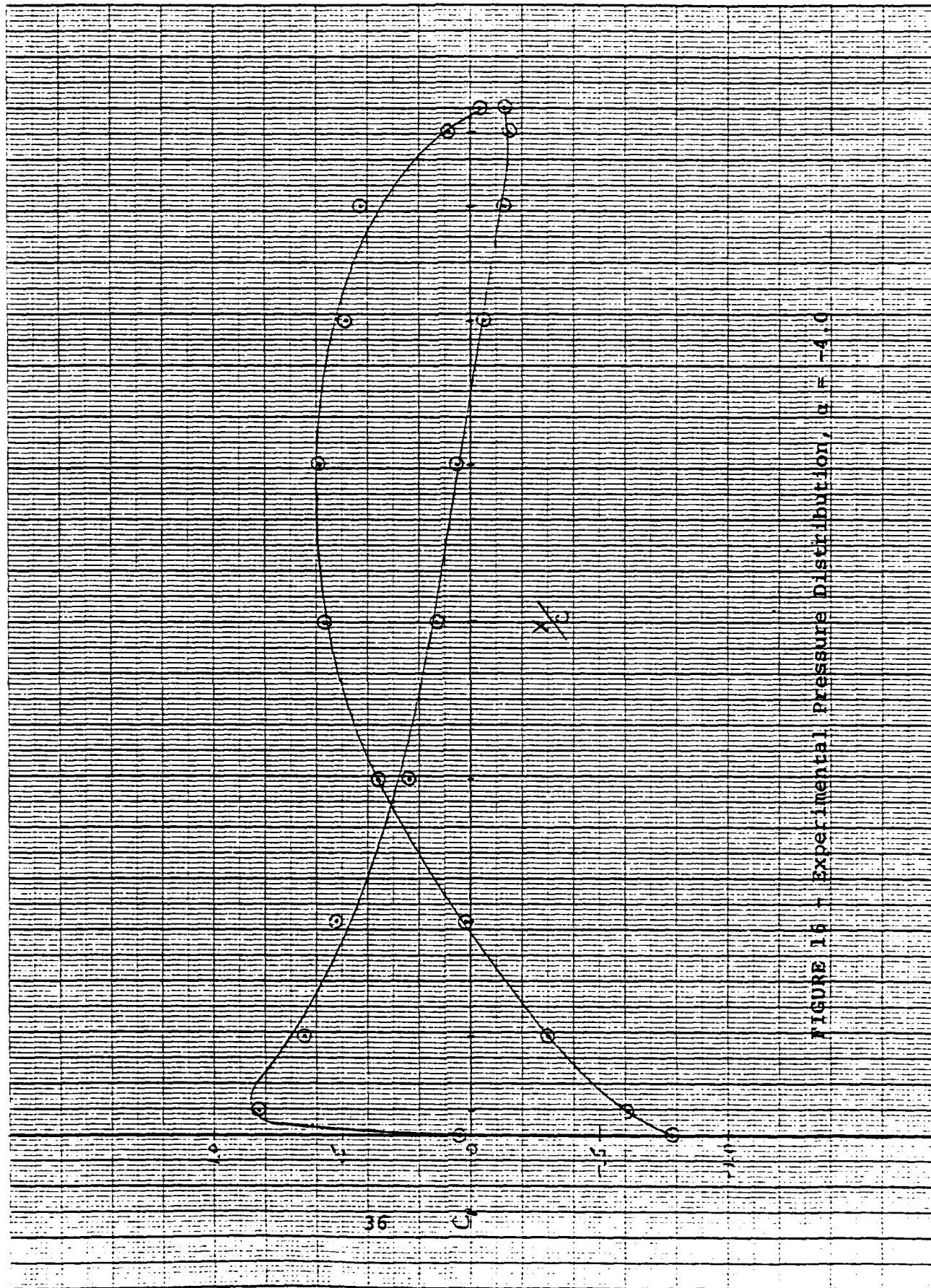
Obviously the difference in comparing the theoretical pressure distributions with the experimental is viscous effects. These effects cause approximately a 75 percent reduction in lift as a result of the boundary layer growth. To compare experimental results with the inviscid results, a simple calculation can be made using the approximation

$$C_L = 2\pi\alpha + 4\pi(\frac{f_o}{C})$$

where $2\pi\alpha$ is the flat plate approximation and $4\pi(\frac{f_o}{C})$ is the camber approximation for the linearize problem with $(\frac{f_o}{C})$ being the camber ratio. At zero angle of attack all lift is from camber and any reduction in lift due to viscous effects would appear as an apparent reduction in the angle of attack. A 25 percent reduction would then mean

$$2\pi\alpha' = .25[4\pi(\frac{f_o}{C})]$$

where α' is the apparent reduction angle. For this foil $(\frac{f_o}{C}) = .05$ and thus

$$\alpha' = 1.4°$$

This means that figure 15, $\alpha = 0.0$ of the experimental results should compare with figure 9, $\alpha = -2.0$ of the theoretical results most closely as it does.

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The same approximation of C_L can be used to determine the angle of zero lift.

$$C_L = 2\pi\alpha + 4\pi(\frac{f_o}{C}) = 0$$

$$\alpha = -5.7°$$

The experimental results in figure 16, $\alpha = -4.0$, show close to a zero lift distribution.

The boundary layer growth shown in the velocity profile graphs of figures 11 through 13 is at times inconsistant. This is most likely due to the fact that the closer to the foil the more difficult it was to obtain good data. Therefore, accurate reliable data in the boundary layer was not taken until the learning process with the laser dopler anemometer was completed. However, there are several significant observations to be made on each figure.

In figures 14 and 15, $\alpha = +4.0$ and 0.0, station 0 shows no distinct boundary layer but a gradual retardation of the flow upon approaching the stagnation point. At station 10 on the convex side of figure 14, $\alpha = +4.0$, the profile shows the very beginning of backflow around the trailing edge. The figure of most interest is figure 16, $\alpha = -4.0$. Here both station 0 and station 1 on the convex side show a gradual retardation suggesting the stagnation point is on the upper

38

surface between the two stations as would be expected. The

flat side at station 2 shows a backflow indicating or hinting

at the presence of a separation bubble in that region and

then reattachment by station 3. The entire flat side of this

figure shows a region thicker than the boundary layer should

be of retarded flow. Since the laser dopler anemometer gives

an average velocity this could be assumed an area of major

turbulence.

V. CONCLUSIONS AND RECOMMENDATIONS

This thesis shows that using the laser dopler anemometer and a transparent model is a good method of obtaining accurate and reliable data about the velocity field around the model. The method does require, however, a certain expertise in the operation of the LDA and this can only be gained by experience. The comparison of theoretical calculations and actual data bears out that the technique is a good one. They also show in the case of the boundary layers in the velocity profiles that as the author gained more experience the data became much better. The fabrication of the foil also is very important and the better job done on that, the easier the collection of data would be.

Although this method is adequate, the author recommends that an attempt or detailed analysis be made of collecting the same data with a different foil orientation. By placing the foil in a horizontal position between the two side windows and having the laser beams radiate parallel to the foil span, the need to pass the beams through the foil would be eliminated.

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APPENDIX A

PRESSURE DISTRIBUTION TABLES

TABLE I

Karman-Trefftz Transformation
Calculation of C_p at +4.0 Degrees Angle of Attack

Upper Surface

x/C	C_p
.001	5.464
.023	.965
.079	.821
.162	.920
.331	1.067
.476	1.067
.714	.796
.819	.554
.906	.268
.969	-.051
.999	-.479

Lower Surface

x/C	C_p
0.001	.693
.020	-.873
.102	-.534
.213	-.402
.350	-.327
.500	-.280
.650	-.254
.787	-.244
.898	-.256
.972	-.314
.999	-.521

TABLE II

Karman-Trefftz Transformation
Calculation of C_p at +2.0 Degrees Angle of Attack

Upper Surface

x/C	C_p
.001	1.6767
.023	.3705
.094	.5238
.201	.7437
.331	.9007
.500	.9419
.645	.8374
.758	.6603
.874	.3664
.958	.0132
.999	-.4740

Lower Surface

x/C	C_p
.001	-.9097
.037	-.5339
.118	-.3608
.234	-.2806
.350	-.2424
.500	-.2157
.650	-.2040
.787	-.2071
.898	-.2307
.972	-.2992
.999	-.5146

TABLE III

Karman-Trefftz Transformation
Calculation of C_p at 0.0 Degrees Angle of Attack

<u>Upper Surface</u>

x/C	C_p
.001	-.471
.032	-.054
.094	.238
.181	.487
.286	.680
.524	.826
.758	.611
.856	.393
.934	.126
.977	-.120
.999	-.470

<u>Lower Surface</u>

x/C	C_p
.001	-.470
.019	-.309
.073	-.226
.153	-.186
.375	-.153
.626	-.153
.744	-.164
.847	-.186
.927	-.226
.980	-.306
.999	-.510

TABLE IV

Karman-Trefftz Transformation
Calculation of C_p at -2.0 Degrees Angle of Attack

Upper Surface

x/C	C_p
.001	-.9670
.042	-.3169
.126	.1063
.221	.3772
.331	.5769
.476	.7043
.621	.6961
.758	.5584
.874	.3170
.958	.0005
.999	-.4683

Lower Surface

x/C	C_p
.001	1.8913
.028	.0911
.102	-.0136
.213	-.0450
.350	-.0648
.500	-.0839
.650	-.1064
.766	-.1311
.882	-.1745
.963	-.2531
.999	-.5057

TABLE V

Karman-Trefftz Transformation
Calculation of C_p at -4.0 Degrees Angle of Attack

Upper Surface

x/C	C_p
.001	.1895
.031	-.6760
.110	-.1790
.201	.1372
.331	.4208
.476	.5830
.621	.6092
.779	.4740
.890	.2435
.969	-.0671
.999	-.4674

Lower Surface

x/C	C_p
.001	6.2811
.037	.4404
.118	.1726
.234	.0759
.374	.0193
.500	-.0176
.650	-.0589
.787	-.1041
.882	-.1518
.963	-.2411
.999	-.5030

TABLE VI

C_p for +4.0 Degrees Angle of Attack

Upper Surface

Station	Nondimensional Velocity	C_p
LE	1.0407	.083
1	1.1224	.260
2	1.2027	.446
3	1.2868	.656
4	1.3425	.802
5	1.3557	.838
6	1.3226	.749
7	1.1707	.371
8	1.0616	.127
9	1.0130	.026
TE	1.0086	.017

Lower Surface

Station	Nondimensional Velocity	C_p
LE	.7381	-.455
1	.6996	-.511
2	.8210	-.326
3	.8838	-.219
4	.9186	-.156
5	.9230	-.148
6	.9511	-.095
7	.9516	-.094
8	.9858	-.028
9	.9994	-.001
TE	1.0294	.060

TABLE VII

C_p for 0.0 Degrees Angle of Attack

Upper Surface

Station	Nondimensional Velocity	C_p
LE	.8350	-.303
1	.8777	-.230
2	1.0340	.069
3	1.1703	.370
4	1.3369	.787
5	1.3269	.761
6	1.2999	.690
7	1.2021	.445
8	1.0863	.180
9	--	--
TE	.9335	-.129

Lower Surface

Station	Nondimensional Velocity	C_p
LE	--	--
1	1.0664	.137
2	.9957	-.009
3	.9962	-.008
4	.9935	-.013
5	.9949	-.010
6	.9802	-.039
7	.9696	-.060
8	.9586	-.041
9	.9493	-.099
TE	--	--

TABLE VIII

C_p for -4.0 Degrees Angle of Attack

Upper Surface

Station	Nondimensional Velocity	C_p
LE	.4691	-.780
1	.6286	-.605
2	.8376	-.298
3	1.0129	.026
4	1.1670	.362
5	1.2522	.568
6	1.2605	.589
7	1.2179	.483
8	1.1948	.428
9	1.0420	.086
TE	.9852	-.029

Lower Surface

Station	Nondimensional Velocity	C_p
LE	1.0213	.043
1	1.2230	.829
2	1.2839	.648
3	1.2358	.527
4	1.1133	.239
5	1.0438	.137
6	1.0302	.061
7	.9789	-.042
8	.9328	-.130
9	.9218	-.150
TE	.9338	-.128

APPENDIX B

STATION SPACING

TABLE IX

Station Spacing

Station	Percent Chord
0	0.0
1	2.4
2	9.5
3	20.6
4	34.6
5	50.0
6	65.4
7	79.4
8	90.5
9	97.6
10	100.0

APPENDIX C

RAW DATA

Date __2 Nov 1977__ Test No. __2__

Angle of Attack __0.0__

Water Temp __73__ Room Temp __73__ Manometer Tubes __7/4__

Station __5__

Lens distance from Window __7 ½__

Initial Pointer Reading __20.53__

__9.60__ Pointer Reading on fe.1 __11.25__ 11.40

Pointer	Distance from wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional velocity at Point	
20.53	12.133	606.9	10.1172	361.0		1.1409	
19.95	11.413	606.1	10.1125	763.2		1.1446	
17.91	10.025	609.5	10.1408	371.9		1.1529	
17.90	9.677	609.7	10.1442	371.5		1.1652	
16.92	7.369	604.6	10.1000	386.0		1.1797	
15.92	6.114	605.8	10.1100	399.8		1.1924	
15.00	4.906	607.3	10.1225	915.7		1.2132	
13.91	3.351	606.5	10.1152	935.0		1.2374	
12.92	2.109	607.3	10.1225	962.3		1.2754	
12.49	1.455	605.1	10.1067	973.6		1.2720	
12.00	.901	606.2	10.1133	971.3		1.2159	
~~11.66~~				~~374~~			Wall Touch
11.50	.633	606.1	10.1272	787.7		1.2931	
~~11.55~~	.734	607.5	10.1242	774.7		1.2144	
11.72	.400	607.2	10.1217	1001.6		1.2257	
11.60	.267	607.5	10.1283	977.5		1.2132	
11.39	-.5.5	602.0	10.1227	877.7		1.2...1	Wall Touch

Date 2 Nov 1777   Test No. 3

Angle of Attack 2.0

Water Temp 79   Room Temp 76   Manometer Tubes 7/4

Station 4

Lens distance from Window 7 2/2

Initial Pointer Reading 20.97

9.56   on foil Pointer Reading ~~ 10.70

Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
20.97	12.709	606.6	10.1167	349.7		1.1262	
19.93	12.331	607.8	10.1267	355.1		1.1323	
18.82	10.839	606.5	10.1158	360.6		1.1408	
17.39	9.578	606.5	10.1158	367.4		1.1478	
16.33	8.316	604.4	10.0831	375.3		1.1640	
15.95	7.008	607.8	10.1267	384.2		1.1703	
14.77	5.727	606.1	10.1292	397.2		1.1877	
13.91	4.735	610.0	10.1450	912.7		1.2143	
12.99	3.044	609.9	10.1442	353.9		1.2675	
12.00	1.735	610.4	10.1477	1021.2		1.3501	:
11.01	.414	612.3	10.1642	679.2		.7762	
10.29	.354	613.7	10.1775	621.4		.8779	
10.67	-.013						IN FOIL
11.17	.627	613.2	10.1717	1374.1		1.3367	
11.08	.507	613.1	10.1702	1315.1			:
						1.3374	

Date 3 Nov 1977   1 of 2   Test No. 4A

Angle of Attack 0.0

Water Temp 90 Room Temp 81 Manometer Tubes 2/4

Station 3

Lens distance from Window 7 35/32

Initial Pointer Reading 20.97

on fo.1   10.60

Pointer	Distance from wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
14.34		609.3		2344			Manual
13.93		632.2		2240			''
13.73		604.7		785.2			''
13.92	4.432	611.1	10.1542	363.5		1.1403	Good Auto
12.96	3.150	610.0	10.1450	363.8		1.1417	''
14.95	5.307	610.1	10.1453	358.7		1.1251	
15.93	7.115	639.9	10.1442	253.9		1.1287	
16.99	8.530	610.2	10.1417	351.2		1.1247	
17.97	9.738	609.8	10.1477	359.2		1.1358	
18.95	11.146	610.4	10.1483	349.0		1.1213	
20.00	12.542	610.1	10.1458	839.0		1.0756	
* 20.97	13.343	601.5	10.0727	326.5		1.1031	
12.94	3.24	607.2	10.1353	364.4		1.1433	
12.01	1.112	607.7	10.1425	372.6		1.1553	
11.52	---	607.2	---	4466			
11.52	1.338	606.7	10.1253	275.4		1.1531	
11.03	.574	607.5	10.1342	5.16		1.1703	

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Date __3 NOV 1977__ Test No. __4A__

Angle of Attack __0.0__

Water Temp __80__ Room Temp __81__ Manometer Tubes __7/4__

Station __3__

Lens distance from Window __7 $\frac{25}{32}$__

Initial Pointer Reading __20.97__

on foil __10.60__

Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
10.41							IN FOIL
11.00	.534	608.0	10.1383	879.7		1.1646	
10.86	.347	606.8	10.1183	999.5		1.1920	?
10.86	.347	608.3	10.1302	977.8		1.1618	
10.78	.240	607.6	10.1350	839.3		1.1115	
10.72	.240	607.6	10.1350	856.1	← better Avg over time	1.1338	
10.72	.16	608.4	10.1317	430.2		.5694	
10.69	.120	608.4	10.1317	423.4		.5604	
10.58							IN FOIL

Date _3 NOV 1977_   Test No. _5_

Angle of Attack _0.0_

Water Temp _80_ Room Temp _81_ Manometer Tubes _7/4_

Station _2_

Lens distance from Window _7 26/32_

Initial Pointer Reading _20.96_

ON F.1   10.30

Pointer	Distance from wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
20.76	14.375	596.3	10.0297	824.5		1.1023	
19.93	12.855	595.8	10.0254	826.4		1.1053	
18.99	11.600	595.7	10.0246	825.4		1.1041	
17.87	10.133	596.0	10.0271	827.2		1.1087	
16.92	8.837	590.0	9.9761	846.0		1.1102	
15.97	7.569	594.2	10.0117	822.3		1.1013	
RF 14.85	6.074	594.1	10.0110	818.7		1.0966	
RF 13.90	4.806	575.9	10.0263	813.7		1.0282	
12.96	3.551	594.1	10.0110	804.5		1.0776	
RF 11.86	2.032	591.5	7.7257	788.1		1.0593	
RF 11.38	1.442	594.2	10.0119	782.1		1.0475	
10.92	.828	590.8	9.9527	772.1		1.0334	
10.92	.822	591.1	9.9355	771.7		1.0365	
10.73	.574	572.4	7.9775	762.7		1.0319	
10.49	.254	571.3	7.9715	770.5		1.0340	
10.37	.073	570.6	7.9 12	767.5		1.0211	
10.22							Foil
RF 17.97	10.265	591.5	7.1121	820.2		1.1014	

Date 3 NOV 1977   Test No. 6

Angle of Attack   0.0

Water Temp 80   Room Temp 78   Manometer Tubes 7/4

Station _____|_____

Lens distance from Window   6 3/32   7 3/32

Initial Pointer Reading   17.99   20.75

on fo.1   9.70

	Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	20.75	14.834	596.0	10.0271	816.5		1.0717	
	19.94	13.669	599.0	10.0525	819.1		1.0726	
	18.33	12.123	592.3	10.0331	815.5		1.0714	
RF	17.90	10.946	596.3	10.0334	813.1		1.0766	
RF	16.94	9.665	592.3	10.0503	814.0		1.0360	
	15.98	8.323	596.1	10.0230	803.2		1.0597	
RF	15.02	7.102	596.3	10.0297	801.6		1.0717	
RF	13.93	6.647	597.6	10.0407	788.4		1.0529	
	12.93	4.378	596.6	10.0322	777.3		1.0387	
RF	11.37	2.897	592.3	10.0502	751.3		1.0030	
RF	10.70	1.602	596.6	10.0322	713.2		.9534	
	10.43	.974	596.2	10.0232	671.7		.8954	
RF	9.94	.324	592.2	10.0502	630.3		.8416	
	10.16	.614	597.3	10.3424	657.3		.8777	
	9.73	.340	596.7	10.0347	613.0		.8266	
	9.62						EME	

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Date __3 NOV 1977__   Test No. __7__

Angle of Attack __5.0__

Water Temp __21__ Room Temp __20__ Manometer Tubes __2/4__

Station ___0___ (Test ahead of LE)

Lens distance from Window __7 32/32__

Initial Pointer Reading __20.98__

on Fo.1 9.80   ⟨11.18⟩

Pointer	Distance from wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
20.98	14.924	594.4	10.0136	812.5		1.0893	
19.79	13.336	591.4	9.9830	809.0		1.0861	
19.01	12.294	590.2	9.9237	810.3		1.0894	
17.83	10.776	592.3	10.0466	811.5		1.0831	
16.94	9.521	596.8	10.0337	807.7		1.0794	
15.83	8.047	596.0	10.0271	801.6		1.0720	
14.89	6.795	593.3	10.0042	795.0		1.0656	
13.73	5.500	596.3	10.0339	786.0		1.0504	
12.97	4.232	595.5	10.0329	773.4		1.0347	
11.88	2.777	596.1	10.0195	745.7		.9920	
12.30	1.462	597.1	10.0364	707.9		.9453	
10.41	.754	599.9	10.0602	680.9		.9076	
9.96	.314	597.2	10.0453	625.6		.8350	
9.47	-.427	593.7	10.0517	584.6		.7777	
9.01	-1.055	593.7	10.0503	731.1		.9754	
9.30	-.667	597.7	10.0555	675.8		.9009	
7.41	-.521	597.7	10.0415	610.1		.8151	
9.68	-.160	597.6	10.0776	582.4		.7765	

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Date 3 Nov 1977   Test No. 8

Angle of Attack   0.0

Water Temp 81   Room Temp 81   Manometer Tubes 7/4

Station   6

Lens distance from Window $7\frac{28}{32}$

Initial Pointer Reading   20.98

Move 4" higher to avoid scratch on window   on foil 11.00

	Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	20.98	13.322	601.8	10.0763	854.1		1.1366	
	19.94	11.934	602.1	10.0788	861.0		1.1455	
	18.34	10.422	601.8	10.0763	867.2		1.1540	
RF	17.73	8.984	602.2	10.0797	874.0		1.1627	
	16.92	7.903	604.0	10.0949	884.3		1.1746	
RF	15.81	6.421	603.9	10.0941	891.7		1.1845	
	14.89	5.193	604.0	10.0949	903.8		1.2005	
	13.91	3.885	602.9	10.0856	917.2		1.2221	
	12.80	2.403	604.3	10.1017	939.1		1.2466	
	11.85	1.135	605.4	10.1067	962.2		1.2731	
	11.41	.547	605.3	10.1058	977.0		1.2963	
	11.12	.160	605.3	10.1100	930.1		1.2999	
	10.96	-.053						IN FOIL

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Date 4 NOV 1977   Test No. 9

Angle of Attack _0.0_

Water Temp _81_ Room Temp _79_ Manometer Tubes _7/4_

Station _7_

Lens distance from Window _7 2½_

Initial Pointer Reading _20.97_

on foil 10.78

Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
20.77	13.603	601.9	10.0771	836.2		1.1127	
19.59	12.161	601.2	10.0712	840.6		1.1192	
18.73	10.746	603.7	10.0741	847.5		1.1258	
17.79	9.491	601.5	10.0737	874.4		1.1637	
16.72	8.196	609.4	10.1400	854.3		1.1324	
15.22	6.723	609.0	10.1367	864.0		1.1429	
17.96	9.525	612.7	10.1775	856.4		1.1283	
14.38	5.473	612.2	10.1633	861.5		1.1366	
13.71	4.178	603.2	10.0331	870.0		1.1564	
12.94	2.822	609.3	10.1167	877.8		1.1635	
12.91	1.643	603.1	10.0773	875.1		1.1577	
11.51	.974	603.9	10.0741	901.5		1.1776	
11.05	.360	602.2	10.0381	915.1		1.2163	
10.73	.267	609.9	10.1442	907.4		1.2021	
10.40	.027	602.2	10.1133	830.7		1.1014	
10.27						IN FOIL	

Date 4 NOV 1977   Test No. 10

Angle of Attack   0.0

Water Temp 81   Room Temp 79   Manometer Tubes 7/4

Station   2

Lens distance from Window   7 26/32

Initial Pointer Reading   20.98

Raised 4" to avoid imperfection on foil   on foil   10.50

Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
20.98	13.790	599.8	10.0573	831.4		1.1083	
19.96	12.628	600.1	10.0619	822.4		1.0960	
18.99	11.823	599.3	10.0573	811.5		1.0217	?
17.38	9.352	599.8	10.0573	834.9		1.1129	
18.93	11.253	599.7	10.0602	835.5		1.1136	
16.92	8.570	600.4	10.0644	833.3		1.1401	
15.22	7.102	600.5	10.0653	837.0		1.1151	
14.82	5.347	601.2	10.0712	835.1		1.1119	
13.91	4.552	600.0	10.0610	835.1		1.1120	
12.95	3.271	600.2	10.0627	832.7		1.1096	
12.00	2.002	601.1	10.0703	826.7		1.1010	
11.39	1.133	601.8	10.0763	832.3		1.0963	
10.92	.561	601.7	10.0771	827.7		1.0865	
10.41	.314	602.1	10.0729	814.0		1.0863	
10.50	.133	601.2	10.0763	805.5		1.0717	
10.41							c.r.l

Date __4 NSU 1977__   Test No. __11__

Angle of Attack __0.0__

Water Temp __81__ Room Temp __79__ Manometer Tubes __7/4__

Station _____ 9 _____

Lens distance from Window __7 35/42 _____

Initial Pointer Reading __20.98__ _____ (10.33)

Raised foil 1" to avoid imperfection in foil   on foil 10.15

Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
20.98	14.457	600.5	10.0653	820.7		1.0936	
19.94	13.069	600.1	10.0619	823.4		1.0773	
18.34	11.600	600.3	10.0672	821.4		1.0940	
17.29	10.332	600.4	10.0644	813.6		1.0706	
16.78	8.734	573.0	10.0441	857.7	—	1.1477	Distance ? refraction
15.99	7.796	580.7	10.0377	783.7		1.0637	
14.87	6.301						

64

Date __12 Feb__   Test No. __12 A__

Angle of Attack __0.0__ Side __Convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __TE (Just aft)__

Lens distance from Window __on foil__

Initial Pointer Reading __30.69__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.98	12.491	158.3		822.0		1.1012	
39.00	11.073	157.7		716.3		1.0777	
38.03	9.793	157.5		814.5		1.0767	
37.10	8.557	157.4		811.9		1.0737	
36.00	7.033	157.3		806.2		1.0767	
35.01	5.747	157.2		797.0		1.0772	
34.07	4.512	157.5		790.2		1.0648	
33.11	3.212	157.7		775.3		1.0426	
32.12	1.933	157.7		747.2		1.0076	
31.70	1.342	157.9		728.7		.9787	
31.52	1.132	158.0		720.2		.9666	
31.38	.941	157.9		710.1		.9537	
31.20	.651	158.0		695.5		.9335	
31.04	.467	158.2		647.5		.8707	
30.90	.230	158.2		495.7		.6618	
30.72	.040	158.4		294.3		.3945	
30.40	-.100	158.4		452.4		.6127	
30.41	-.274	158.4		556.3		.7466	
30.26	-.554	158.4		665.7		.8353	

Date ___I1 Jan___   Test No. __14__

Angle of Attack ___2.0 list___

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ___LE___

~~Lens distance from Window~~ on foil surface

Initial Pointer Reading ___29.77___

Pointer	Distance from wall	Manometer RPM	Freestream velocity ftkc	Laser Volts	Velocity at Point ftkc	Non-dimensional velocity at Point	
29.77	.000	160.1		No track			
30.16	.227	160.2		297.9		.3970	?
30.38	.521				} unable to track	locked	
31.02	1.395				} laser	. . . .	
39.92	13.336	160.7		760.2		1.0026	
38.25	11.527	160.7		760.7		1.0039	
37.90	10.559	160.7		760.8		1.0034	
36.94	9.273	160.9		759.3		1.0008	
36.00	8.023	160.8		756.1		.9972	
34.88	6.527	160.7		753.3		.9735	
33.92	5.246	160.9		750.6		.9573	
32.99	4.005	161.0		745.7		.7325	
32.51	. . .	. . .	. . .	. . .	. . .	. . .	
. . .	. . .	. . .	. . .	. . .	. . .	. . .	
. . .	. . .	. . .	. . .	. . .			

RF
RF

66

Date 31 Jan   Test No. 15

Angle of Attack   0.0 flat

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station ___ TE ___

~~Lens distance from Window~~ on foil surface

Initial Pointer Reading ___ 30.45

Pointer	Distance from wall	RPM	Freestream velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional velocity at Point	
40.13	12.922	161.4		759.6		.9931	
38.85	11.213	161.5		758.1		.9955	
37.90	9.945	161.4		754.6		.9915	
36.96	8.690	161.4		752.6		.9837	
35.83	7.182	161.5		746.7		.9805	
34.70	5.940	161.7		738.0		.9679	
33.94	4.659	161.5		726.3		.9537	
33.00	3.404	161.6		705.0		.9252	
RF 32.01	Same as with test 14. The was						
to just off the floor of hersaw when too close							
to the edge can ... with gate too little							

67

Date _31 Jan & 1 Feb_   Test No. _16_

Angle of Attack _0.0 flat_

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station _9_

~~Lens distance from Window~~ _on foil surface_

Initial Pointer Reading _~~30.72~~ 33.21_

	Pointer	Distance from Wall	Cascade RPM	Freestream Velocity ft/sec	Laser volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.63	11.240	161.4		759.1		.9974	
RF	39.65	9.932	161.5		759.3		.9970	
RF	38.52	8.423	161.7		748.7		.9819	
RF	37.28	6.768	162.1		750.7		.9824	
RF	36.00	5.059	162.9		752.7		.9799	
RF	34.29	could not get signal						1 Feb
	33.93	2.296	157.5		708.9		.9545	did NOT RF
	33.93	2.296	162.0		723.5		.9536	
RF	33.00	1.055	160.8		719.7		.9493	
	33.01			Non dim vel				IN Feb 1
RF	32.74	.703	160.3	.7046	532.6			
	32.68	.627	162.2	.7101	536.4			
	32.50	.337	160.2	.6823	515.8			
	32.34	.174	160.4	.6477	489.7			
	32.24	.241	157.7	.5241	393.7			

68

Date __1 Feb__ Test No. __17__

Angle of Attack. __0.0 flat__

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station _____8_____

Lens distance from Window __on foil__

Initial Pointer Reading __32.25__

	Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	41.11	11.837	155.7		751.4		1.0041	Great Signal
	40.01	10.359	158.8		742.9		.9721	
RF	39.03	7.117	159.0		745.5		.9943	great working, in no writing
RF	38.09	7.796	159.4		740.7		.9854	
RF	37.00	6.341	160.0		747.6		.9909	
	36.03	5.046	160.0		734.3		.9733	
RF	35.09	3.791	160.3		739.6		.9784	
	34.00	2.336	160.8		731.8		.9651	
	33.34	1.455	160.9		730.4		.9627	
RF	32.85	.841	161.3		727.0		.9558	
	32.71	.614	161.5		731.2		.9601	
	32.53	.374	161.8		731.4		.9586	
	32.40	.200	161.5		717.6		.9423	
	32.30	.067	161.5		719.2		.9326	
	32.25	0.000	161.6		724.0		.9337	
						½ turn	last single	
						last could agree		good

Date ___ 1 Feb ___   Test No. __ 18 ___
       Angle of Attack __ 0.0 flat __
Water Temp ___ Room Temp ___ Manometer Tubes ___
       Station ____ 7 ____
Lens distance from Window ___ 30 foil
Initial Pointer Reading ___ 32.00 ___

Pointer	Distance from wall	Manometer cm	Freestream velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.12	10.339	157.0		742.3		.9963	
39.02	7.451	157.1		739.0		.9913	
38.09	7.130	157.0		736.7		.9871	
37.17	6.701	157.8		747.5		.9945	
36.04	5.293	157.9		729.3		.9802	
35.09	4.125	158.1		734.4		.9851	
34.15	3.370	158.1		733.7		.9841	
33.02	1.262	158.1		727.2		.9754	
32.73	.974	158.1		729.5		.9785	
32.54	.721	158.1		726.2		.9741	
32.41	.547	158.2		723.3		.9696	
32.25	.334	158.0		714.0		.9533	
32.09	.120	158.0		648.3		.8701	
31.94	-.030	158.1		535.7			?.!.!!
						.7166	

70

Date __1 Feb__ Test No. __19__

Angle of Attack __0.0 Flat__

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station ___6___

Lens distance from Window __on foil__

Initial Pointer Reading __31.64__

Pointer	Distance from wall	Manometer RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.13	11.587	158.3		745.1		.9982	
39.07	10.172	158.3		746.4		.9999	
38.08	9.850	158.4		744.6		.9969	
37.15	7.607	158.2		744.2		.9976	
36.04	6.127	158.3		730.5		.9786	
RF 35.10	4.272	158.4		742.7		.9943	Dezripie
33.77	3.391	158.2		755.8		1.0131	front 2
32.02	2.109	158.2		753.4		1.0099	
35 32.42	1.295	158.4		732.6		.9320	Good
32.26	1.081	158.2		731.2		.9302	2-1
32.07	.354	158.2		727.3		.9749	
RF 31.92	.627	158.2		731.7		.9773	
31.72	.360	158.2		570.1		.7642	
31.53	.107	158.1		409.0		.5436	

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Date ___1 Feb___   Test No. ___20___

Angle of Attack ___0.0 flat___

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station ___5___

Lens distance from Window ___on foil___

Initial Pointer Reading ___31.45___

	Pointer	Distance from Wall	Manometer RPM	Freestream Velocity Ft/sec	Laser Volts	Velocity at Point Ft/sec	Non-dimensional Velocity at Point	
	40.15	11.614	157.3		750.0		1.0047	
	39.09	10.135	153.4		750.3		1.0045	
	38.11	3.390	153.4		751.5		1.0061	
	37.01	7.432	152.5		752.5		1.0082	
	36.05	6.141	153.2		755.1		1.0122	
RF	34.93	4.645	157.2		743.2		.9964	
	34.00	3.404	153.2		741.9		.7945	
	32.89	1.922	153.2		732.1		.9394	
	32.41	1.382	152.2		731.6		.9807	
RF	32.10	.868	157.3		741.3		.9938	
	31.94	.654	153.2		742.2		.9949	
	31.73	.441	153.4		733.4		.9386	
	31.63	.240	153.4		709.0		.7492	
	31.45	.013	15		552.0		.9735	losing cont Manual
RF	31.46	.013	153.2		610.6		.2120	turbing

Date 1 Feb   Test No. 21

      Angle of Attack 0.0

Water Temp ____ Room Temp ____ Manometer Tubes ____

      Station 4

Lens distance from Window on foil

Initial Pointer Reading 31.46

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional velocity at Point	
40.14	11.587	158.2		747.6		1.0022	
39.02	10.172	158.3		746.7		1.0003	
37.92	8.704	158.2		744.1		.9975	
37.00	7.395	158.2		744.7		.9983	
36.05	6.127	158.3		745.4		.9926	
35.10	4.857	158.2		739.0		.9906	
34.00	3.371	158.5		745.2		.9968	
33.04	2.109	158.5		739.3		.9892	
32.55	1.455	158.3		741.8		.9938	
32.40	1.255	157.9		740.4		.9944	
32.23	1.028	157.8		740.0		.9945	
32.09	.841	157.7		740.1		.9952	
31.92	.614	157.6		735.2		.9935	
31.77	.414	157.5		732.1		.9857	
31.61	.200	157.5		633.0		.9264	
31.46	.000	157.5		575.2		.7746	

Date __2 Feb__   Test No. __22__
　　　Angle of Attack __0.0 Flat__
Water Temp ___ Room Temp ___ Manometer Tubes ___
　　　　Station ___3___
Lens distance from Window __20 foil__
Initial Pointer Reading __31.59__

	Pointer	Distance from Wall	Revolutions RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.16	11.440	159.5		755.6		1.0046	
RF	37.08	9.998	159.8		755.5		1.0026	
	37.99	8.543	159.7		761.6		1.0107	
RF	37.01	7.235	159.7		754.1		1.0007	
	36.05	5.954	160.0		733.7		.9725	?
RF	34.97	4.512	159.7		755.5		1.0020	
	34.00	3.217	159.9		754.5		1.0007	
RF	33.03	1.922	160.1	- -	754.7	- -	.9997	
	32.51	1.228	160.2		755.0		.9994	
	32.42	1.108	160.2		753.4		.9973	
	32.25	.881	160.1		752.1		.9762	
	32.07	.667	160.2		753.2		.9771	
	31.71	.467	160.2		752.2		.9731	
	31.78	.254	160.2		722.9		.9569	
F	31.61	.027	160.2		691.7		0.0030	2.1

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Date __2 Feb__   Test No. __22__

Angle of Attack __2.5 flat__

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station _____2_____

Lens distance from Window __on foil__

Initial Pointer Reading __31.40__

	Pointer	Distance from Wall	Manometer RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.18	11.720	152.3		751.0		1.0061	
	39.08	10.252	152.3		741.4		.9932	
RF	37.97	8.720	152.2		746.0		1.0000	
RF	37.00	7.475	153.1		746.3		1.0010	
RF	36.04	6.174	153.1		744.8		.9990	
RF	35.10	4.939	152.0		744.1		.9987	
RF	34.00	3.471	152.0		742.6		.9767	
RF	33.04	2.189	152.9		743.5		.9956	
RF	32.41	1.348	153.1		742.8		.9964	
	32.24	1.121	152.1		741.0		.9939	
RF	32.09	.921	152.9		745.0		1.0006	
	31.94	.721	52.9		744.0		.9992	
	31.72	.507	152.9		741.4		.9957	
RF	31.61	.230	52.9		727.6		.9772	) foil
	31.47	.073	152.9		633.2		.8423	> off foil
	31.52	.160	152.9		687.0		.9254	)

Date __2 Feb__   Test No. __24__

Angle of Attack __2.5 flat__

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station ___L___

Lens distance from Window __on foil__

Initial Pointer Reading __31.50__

Pointer	Distance from Wall	Anemometer RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.72	11.720	158.0		747.2		1.0029	
39.02	10.119	158.2		750.4		1.0059	
RF 37.98	Beam hitting LE of test section bolt + small amt					—	
RF 37.01						②	See back
RF 36.02						②	
RF 34.96	4.612	160.5		743.7		.9826	
3F 33.99	3.324	157.2		737.1		.9319	
32.99		159.2		557.2	—		Looks like noise
32.89	1.727	159.3		748.5		.9964	Good signal
32.50	1.335	159.3		752.9		1.0023	
32.33	1.103	159.4		753.1		1.0019	
32.19	.921	159.4		754.9		1.0043	
32.02	.667	159.4		760.5		1.0113	
31.86	.431	159.		772.0		1.0268	
31.70	.267	159.6		781.0		1.0417	
31.53	.040	159.7		783.1		1.0464	

Date __2 Feb__   Test No. __25__

Angle of Attack __-4.0 flat__

Water Temp ____ Room Temp ____ Planometer Tubes ____

Station ____LE____

Lens distance from Window __on foil__

Initial Pointer Reading __31.97__

Pointer	Distance from Wall	Planometer RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	10.719	159.7		809.2		1.0762	
39.00	7.324	157.7		811.6		1.0794	
37.90	7.916	159.7		816.7		1.0862	
36.95	6.648	159.?		815.3		1.0836	
ᴸF 35.99	5.366	160.1		825.7		1.0954	
34.89	3.385	159.1	·	824.4		1.1005	
33.93	2.616	159.2		827.0		1.1026	
33.72	2.416	159.3		827.2		1.1029	
ᴿF 32.97	1.335	159.4		821.1		1.0941	
32.81	1.121	159.4		817.8		1.0897	
32.65	.908	159.4		813.4		1.0838	
32.49	.674	159.4		804.0		1.0713	
ᴷF 32.34	.474	159.5		792.4		1.0555	
32.18	.280	159.5		774.?		1.0307	
32.00	.040	159.5		744.2		.9910	
32.11	.187	159.5		767.?		1.0213	

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Date __2 Feb__   Test No. __26__

Angle of Attack __-4.0 flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____TE____

Lens distance from Window __on foil__

Initial Pointer Reading __29.91__

Pointer	Distance from wall	RPM	Freestream Velocity Ft/sec	Laser Volts	Velocity at Point Ft/sec	Non-dimensional Velocity at Point	
39.99	13.456	159.6		781.3		1.0397	
39.00	12.134	159.6		779.8		1.0377	
38.05	10.366	159.6		772.7		1.0363	
36.94	9.334	159.6		771.4		1.0266	
36.00	8.130	159.7		765.6		1.0182	
34.87	6.647	159.7		749.8		.9972	
33.92	5.353	177.7		757.7		1.0077	
32.98	4.098	159.7		740.6		.9850	
32.00	2.790	159.3		702.6		.9338	
31.09	1.575						unable to track
30.74	unable to	loose	because	when		loc	
	edge	of	foil	left	no certificate		into
	on	beam					
29.71							

Date __2 Feb__   Test No. __27__

Angle of Attack __-4.0 flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____9____

Lens distance from Window __on foil__

Initial Pointer Reading __29.33__

	Pointer	Distance from wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	39.92	13.483	158.8		777.9		1.0404	
RF	39.00	12.174	159.1		773.5		1.0326	
RF	38.04	10.393	159.4		776.7		1.0350	
	36.94	7.424	159.4		773.1		1.0301	
	36.00	8.170	159.5		750.7		.9976	
RF	35.02	6.861	159.7		763.6		1.0155	
	33.92	5.373	159.8		746.7		.9924	
RF	32.98	4.138	159.9		744.1		.9884	
RF	32.01	2.343	160.0		694.4		.9218	
RF	30.90	1.363	160.2		556.0		.7371	
	30.75	1.161	160.3		532.2		.7051	
	30.60	.961	160.3		517.3		.6354	
RF	30.41	.708	160.3		269.6		.3572	Erratic
RF	30.29	.547	160.5		236.3		.3127	"
	30.10	.294	160.5		003.1		.0107	"

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Date 3 Feb   Test No. 18

Angle of Attack -4.0   Side flat

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____ 8 _____

Lens distance from Window __ on foil __

Initial Pointer Reading __ 30.12 __

	Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.01	13.202	152.4		764.1		1.0245	
RF	39.00	11.854	152.6		771.4		1.0330	
	38.04	10.572	153.7		762.2		1.0281	
	36.93	7.871	153.7		759.5		1.0152	
RF	36.00	7.349	159.6		749.3		.7971	
	35.02	6.541	157.6		767.7		1.0176	
	33.93	5.036	159.7		745.6		.9916	
PF	32.97	3.704	160.0		747.6		.7924	
	32.01	2.523	160.0		702.7		.9328	
RF	31.06	1.255	160.6		634.0		.7723	
	30.90	1.041	160.7		559.3		.7399	
	30.74	.733	161.0		550.0		.7282	
	30.50	.641	161.0		523.3		.6703	
	30.43	.414	161.1		502.7		.6643	
	30.29	.237	161.0		472.0		.6416	
	30.11	-.013	161.6		438.0		.5365	

Date 2 Feb   Test No. 29
          Angle of Attack   -4.0   Side flat
Water Temp ____ Room Temp ____ Manometer Tubes ____
          Station _____ 7 _____
Lens distance from Window   on foil
Initial Pointer Reading _____ 30.12 _____

	Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	39.99	13.176	158.4		779.5		1.0452	
	39.00	11.354	158.2		775.2		1.0401	
RF	38.04	10.572	158.1		772.4		1.0376	
	36.94	7.104	158.1		769.5		1.0337	
RF	36.00	7.349	158.0		753.9		1.0134	
	35.02	6.541	158.1		762.9		1.0249	
	34.09	5.300	158.1		745.4		1.0014	
RF	32.98	3.313	158.1		728.7		.9789	
	32.05	2.516	158.1		713.7		.9588	
RF	31.08	1.282	157.7		569.5		.7647	
	30.71	1.055	157.8		544.7		.7331	
	30.74	.823	157.8		527.1		.7095	
	30.59	.627	157.7		512.0		.6887	
	30.42	.400	157.7		495.7		.6668	
	31.31	1.527	157.0		605.2		.8135	
RF	31.68	2.032	157.7		672.3		.7043	
RF	30.27	.200	157.8		377.8		.5243	

30.10   on foil

Date __3 Feb__   Test No. __30__

    Angle of Attack __-4.0__   Side __flat__

Water Temp _____ Room Temp _____ Manometer Tubes _____

    Station _____6_____

Lens distance from Window __on foil__

Initial Pointer Reading __31.21__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.01	11.747	158.5		735.2		1.0522	
39.00	10.379	158.4		733.4		1.0504	
38.05	7.131	158.4		733.2		1.0510	
36.94	7.649	158.3		730.9		1.0477	
35.99	6.381	158.3		776.5		1.0418	
35.03	5.099	158.3		750.7		1.0075	
34.09	3.345	158.3		767.3		1.0302	
32.99	2.326	158.3		742.1		.9957	
32.28	1.428	158.3		641.2		.8603	
32.71	2.002	158.1		715.2		.9602	
32.50	1.722	158.1		679.4		.9121	
32.00	1.055	158.1		578.7		.7776	
31.86	.868	158.1		554.2		.7430	
31.70	.654	158.2		517.6		.6976	
31.53	.427	158.1		472.7		.6619	
31.38	.227	158.2		463.0		.6211	
31.21	.000	158.1		404.7		.5160	

Date _3 Feb_   Test No. _31_

     Angle of Attack _-4.0_   Side _Flat_

Water Temp ____ Room Temp ____ Manometer Tubes ____

     Station _____5_____

Lens distance from Window _on foil_

Initial Pointer Reading _31.16_

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	11.801	158.9		795.5		1.0633	
39.00	10.466	158.2		795.9		1.0645	
38.04	9.134	158.9		797.1		1.0654	
36.94	7.716	153.7		796.5		1.0646	
36.00	6.461	158.1		795.1		1.0628	
35.02	5.153	157.2		794.1		1.0621	
33.93	3.698	159.0		721.4		1.0433	
32.98	2.430	158.7		751.0		1.0033	
RF 32.60	1.789	153.6		742.9		.9949	
32.10	1.255	153.6		644.0		.8651	
31.86	.934	153.7		554.0		.7414	
31.70	.721	153.6		513.0		.6737	
31.53	.474	153.6		431.3		.5776	
31.39	.307	153.6		433.6		.5574	
31.21	.067	153.6		355.0		.4754	
31.07							

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Date __3 Feb__ Test No. __32__

Angle of Attack __-4.0__ Side __flat__

Water Temp _____ Room Temp _____ Manometer Tubes _____

Station _____4_____

Lens distance from Window __on foil__

Initial Pointer Reading __31.20__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
37.99	11.734	152.2		205.4		1.0772	
37.00	10.412	153.2		208.4		1.0353	
38.04	9.131	153.3		212.3		1.0912	
36.93	7.649	153.3		206.1		1.0215	
35.91	6.287	153.3		209.0		1.0354	
35.03	5.113	153.5		726.6	⎫	.9737	
34.55	4.472	153.6		569.3	⎬ looks Bad	.7624	
34.24	4.052	153.6		372.4	⎭	.4937	
35.77	6.101	152.7		223.2		1.1025	
35.00	5.073	159.1		229.5		1.1073	
34.09	3.833	153.2		229.5		1.1200	
33.12	2.663	159.3		235.5		1.1132	
32.65	1.936	159.3		210.1		1.0301	
32.32	1.475	153.5		763.7		1.0132	
32.12	1.302	153.6		763.6		.9323	
32.03	1.068	158.6		214.6		.7179	
31.35	.762	557		474.6		.6624	

(CONT)

Date ___3 Feb___   Test No. ___32___

       Angle of Attack ___-4.0___ Side _Flat_

Water Temp _____ Room Temp _____ Manometer Tubes _____

       Station, _____4_____

Lens distance from Window ___on foil___

Initial Pointer Reading ___31.20___

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
31.70	.667	159.7		321.1		.5063	
31.53	.441	159.7		296.9		.3949	
31.40	.217	159.9		158.4		.2104	
31.22	.027	159.3		107.3		.1426	

Date __2 Feb__   Test No. __33__

Angle of Attack __-4.0__   Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____3_____

Lens distance from Window ____on foil____

Initial Pointer Reading ____31.46____

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.02	11.427	153.0		204.7		1.0217	
39.00	10.045	153.1		813.3		1.0726	
38.04	3.784	153.1		218.3		1.0993	
36.95	7.329	153.3		230.9		1.1148	
36.00	6.060	153.2		231.5		1.1163	
35.04	4.779	153.1		358.5		1.1533	
34.09	3.511	153.0		220.7		1.1340	
32.97	2.029	1570		3.3.3		1.2358	
32.50	1.388	153.2		303.4		1.2129	
32.22	1.161	153.0		839.2		1.1281	
32.13	.974	153.0				.8303	
32.00	.721	153.0		3.3.2		.5097	
31.27	.547	153.9		161.0		.2171	
31.73	.320	153.0		43.0		.0573	
31.53						30.000	

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Date __3 Feb__   Test No. __54__

Angle of Attack __-4.0__ Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____2____

Lens distance from Window ____ on foil ____

Initial Pointer Reading ____ 31.__ ____

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.02	11.120	157.7		714.0		1.0828	
39.00	9.253	157.7		733.1		1.0769	
37.04	5.427	157.7		742.9		1.0948	
36.94	7.008	157.6		820.4		1.1063	
36.00	5.753	157.4		7__._		1.1248	
35.02	4.445	157.6		7__._		1.1444	
33.91	2.963	157.5		781._		1.1837	
33.00	1.749	157.5		852.6		1.1497	
32.64	1.263	157.6		755.7	Not Sure Might have been on Manual	1.1029	
32.32	.841	157.7		232.4		1.1076	
32.__	.654	157.7		552.3		.7448	
__.__	.801	157.7		7__.__		1.2035	
3__.__	1.215	157.7		7__.1		1.2173	
30.__	1.615	157.6		7__.7		1.2339	
31.__	2.833	157.6		7__.2		1.1977	
3_.__	.654	15_._		5__.5		.7046	
_._	.314			_.7		1.1323	

Date _3 Feb_   Test No. _24_

     Angle of Attack _-10_ Side _out_

Water Temp ____ Room Temp ____ Manometer Tubes ____

     Station _2_

Lens distance from Window _on foil_

Initial Pointer Reading _31.70_

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
32.00	.414	1577.2 1577.2		131.0		.1770	
31.85	.214	1577.3		-84.9		-.1146	
RF 31.70					on Foil		

Date _2 Feb._ Test No. _25_

Angle of Attack _-4.0_ Side _____

Water Temp ____ Room Temp ____ Manometer Tubes _=15=_

Station _____1_____

Lens distance from Window _on foil_

Initial Pointer Reading _31.82_

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
37.98	10.273	151.1		2......		1.0755	
-9.0)	9.525	157.0		203.6		1.0762	
RF 37.0	Light	scatter ok	LE use	excessive	see enen	(n)	
26.98		4.0		311.7	}		
36.00		57		9.07	{ (Plenum track (middle))		
36.51		53.0		844.9	}		
2.15		512.5		9.13..			
24.03		157.0		--5.1			
35.91		47.1		271.3			
36.94	6.225	153.1		8.57		1.0951	
RF 36.52	5.720	153.2		221.4		1.1023	
35.03	4.225	155.1		224.7		1.1079	
34.50	3.522	153.2		213.7		1.0727	
24.12	7.44	12.3		...2		1.1234	
22.15	2.176	152.4		7-2.9		1.1333	
31.35	1.442	...		2.32		1.1576	
1.75	1.252	14.2		1.7		1.1556	

Date ___ ?F. ? ___   Test No. ^{2 of 2} __?5__

     Angle of Attack __-4.0__ Side __Flat__

Water Temp ___ Room Temp ___ Manometer Tubes ___

     Station ___ 1 ___

Lens distance from Window ___ on foil ___

Initial Pointer Reading ___ 31.?? ___

	Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
RF	32.??	1.103	152.7		7?4?		1.1702	
	32.50	.903	152.6		8?5?	⌒	1.1857	
⊙	32.32	.667	152.7		905.1	)	1.2113	
	32.19	.494	152.7		?13.7	(	1.2230	
	32.11	.337	152.8		?12.1	? reproducible 1.2199		
	32.08	.347	152.8		?91.7	)	1.1926	
HF	32.00	.240	152.5		?.. 4	} could not track readings		
	31.84	.027			←	-.5536		

Date 6 Feb   Test No. 36

Angle of Attack +4.0   Side flat

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____ LE ____

Lens distance from Window ____ on foil ____

Initial Pointer Reading ____ 31.00 ____

Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point
40.00	12.014	159.4		716.3		.9562
39.00	10.679	159.3		712.6		.9518
38.04	9.393	159.7		702.7		.9445
37.01	8.023	159.7		703.0		.9366
35.89	6.661	159.2		696.3		.9271
35.02	5.346	159.8		690.9		.9199
34.09	4.125	159.9		691.1		.9196
32.92	2.643	159.9		671.6		.8937
PF 31.97	1.295	160.3		571.1		.7859
RF 31.53	.708	160.4		556.4		.7321
IF 31.07	while to focus bright spot in focus pattern					
30.95	some again					
↓	light continued in and in 2nd direction to eye piece					
↓						

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Date __6 Feb__   Test No. __37__

Angle of Attack __+4.0__ Side __Flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __TE__

Lens distance from Window __on Foil__

Initial Pointer Reading __32.93__

	Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	29.97	9.393	157.4		735.?		.9947	
	39.00	8.103	157.4		735.3		.9940	
	38.05	6.835	157.4		735.0		.9936	
	36.74	5.353	157.3		729.2		.9864	
PF	36.00	4.075	157.1		727.6		.9855	
	35.02	2.777	157.1		722.3		.9783	
	34.10	1.562	157.1		741.0		1.0036	
RF	33.76	1.103	157.1		770.0		1.0429	
	33.61	.902	157.0		770.7		1.0445	
R=	33.45	.674	156.9		737.1		.9976	
	33.29	.431	157.0		744.3		1.0087	
	33.13	.267	156?		755.6		1.0294	
	32.98	.067						??

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Date __6 Feb__   Test No. __38__

     Angle of Attack __+4.0__   Side __flat__

Water Temp ___ Room Temp ___ Manometer Tubes ___

     Station _____9_____

Lens distance from Window ___on foil___

Initial Pointer Reading ___33.09___

Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
34.12	1.375	157.4		736.7		.9759	
33.67	.924	157.7		733.6		.9766	
33.60	.681	157.5		726.2		.9311	
33.44	.467	157.5		733.8		.9994	
33.29	.267	157.6		733.4		.9361	
33.12	.040	157.6		722.1		.9349	
34.99	2.536	157.7		733.5		.9956	
36.00	3.735	157.6		710.4		.9591	
36.90	6.026	157.7		733.8		.9351	
32.00	6.554	157.7		732.6		.9373	
33.95	7.223	157.3		737.1		.9737	
40.04	7.278	157.7		733.7		.9313	
35.97	3.321	157.7		735.7		.9716	

1.0

1.1

1.25

4.5
5.0
5.6
6.3

2.8
3.2
3.6
4.0

1.4

2.5

2.2

2.0

1.8

1.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Date __6 Feb__   Test No. __39__

Angle of Attack __+4.0__ Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __2__

Lens distance from Window __on foil__

Initial Pointer Reading __33.79__

	Pointer	Distance from wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	39.92	9.598	157.6		729.9		.9854	
	38.85	8.070	157.6		731.5		.9876	
RF	37.90	6.821	157.8		721.8		.9733	
	36.94	5.540	157.8		732.2		.9873	
RF	36.60	4.235	157.7		732.0		.9877	
.F	35.02	2.977	157.7		732.0		.9890	
RF	34.09	1.735	157.9		733.9		.9890	
	33.70	1.215	157.7		733.5		.9897	
	33.60	1.031	157.7		735.2		.9920	
	33.45	.831	157.6		732.2		.9886	
	33.30	.631	157.6		726.6		.9810	
.F	33.12	.441	157.7		730.6		.9853	
RF	33.00	.230	157.5		729.4		.9862	
	33.30						on foil	

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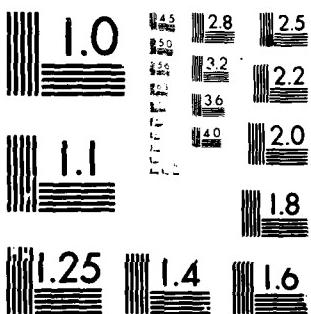
Date __14 Feb__   Test No. __40__

Angle of Attack __+4.0__   Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____7_____

Lens distance from Window ____on foil____

Initial Pointer Reading ____33.50____

Readjusted laser   (Not real good data)

	Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.00	10.312	157.9		716.0		.9648	
RF	38.93	8.523	158.0		719.1		.7634	
RF	38.04	7.395	157.2		716.7		.9664	
RF	36.94	5.927	157.2		717.7	.	.9677	
	36.00	4.672	157.9		713.2		.9611	
RF	33.76	1.692	156.5		716.9		.9747	
	34.33	2.443	156.6		713.7		.9697	
	33.29	1.055	156.6		713.8		.9699	
RF	33.12	.823	156.6		723.3		.9828	
	32.99	.654	156.6		721.6	Weak trace	.9895 erratic but reproduced	
	32.80	.400	156.6		710.7	then	reasoned .9637	
	32.64	.157	156.7		709.1		.9516	
	32.50							on foil

Date __14 Feb__   Test No. __41__

Angle of Attack __+4.0__   Side __Flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____ 6 _____

Lens distance from Window __on foil__

Initial Pointer Reading __32.20__

Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.01	10.426	156.9		713.4		.9675	
39.00	9.077	156.9		717.5		.9730	
38.05	7.709	157.0		720.5		.9765	
RF 37.10	6.541	156.9		720.6		.9772	best signal of data set
35.99	5.059	156.9		717.2		.9726	
35.01	3.751	157.0		718.3		.9735	
RF 33.92	2.276	156.9		711.4		.9648	
RF 33.21	1.348	156.8		709.5		.9628	
33.13	1.220	156.8		713.3		.9679	
32.98	1.041	156.7		710.9		.9653	
32.80	.801	156.8		707.5	erratic but	.9601	neid
32.65	.601	156.8		708.7	track	.9617	
32.50	.400	156.9		707.2		.9599	
32.33	.174	156.7		702.3		.9511	
32.20							on foil

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Date __14 Feb__   Test No. __42__

Angle of Attack __+4.0__   Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____5____

Lens distance from Window __on foil__

Initial Pointer Reading __32.14__

Pointer	Distance from Foil 1	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.97	10.452	156.6		713.5		.9695	
39.00	9.157	156.6		711.1		.9662	
38.04	7.376	156.6		713.2		.9690	
36.93	6.394	156.6		711.5		.9667	
36.16	5.366	156.6		706.4		.9598	
35.02	3.345	156.6		705.2		.9582	
33.92	2.376	156.6		698.5		.9491	
33.12	1.308	156.5		699.4		.9509	
32.99	1.135	156.7		700.8		.9516	
32.80	.831	156.6		696.6		.9465	
32.65	.631	156.6		695.7		.9453	
32.50	.431	156.7		695.0		.9437	
32.33	.254	156.6		677.5		.9230	
32.19	.067	156.6		519.9		.7064	

Date ___14 Feb___   Test No. ___43___

Angle of Attack ___+4.0___ Side ___flat___

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station ___4___

Lens distance from Window ___on foil___

Initial Pointer Reading ___32.01___

	Pointer	Distance from wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.00	10.666	156.9		705.4		.9566	
RF	39.00	9.331	157.0		704.4		.9547	
	37.90	7.963	157.0		703.2		.9530	
	36.95	6.594	156.9		696.6		.9447	
	36.00	5.326	157.1		694.4		.9405	
	35.01	4.005	157.1		690.5		.9352	
RF	34.09	2.777	157.3		681.0		.9212	Erratic
RF	32.98	1.295	156.7		695.7		.9447	
RF	32.80	1.055	156.3		679.5		.9250	
	32.64	.341	156.3		702.4		.9644	
RF	32.50	.654	157.0		541.7		.7342 →	Manual
	32.33	.437						

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Date ___15 Feb___   Test No. __44__

    Angle of Attack ___+40___ Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

    Station ____3____

Lens distance from Window ___on foil___

Initial Pointer Reading ___31.38___

    Good data (started ....)

Pointer	Distance from wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.01	11.520	156.6		708.1		.9621	
39.00	10.172	156.9		690.5		.9364	
38.04	8.890	157.0		701.3		.9505	
36.92	7.395	156.3		693.5		.9441	
36.00	6.167	156.5		637.8		.9351	
35.02	4.359	156.4		631.6		.9273	
34.10	3.631	156.4		674.1		.9171	
32.97	2.149	156.7		663.4		.9076	
32.80	1.896	156.6		662.0		.9063	
32.64	1.682	156.6		665.7		.9045	
32.50	1.495	156.7		662.0		.9003	
32.32	1.255	156.2		663.9		.9007	
33.18	1.063	156.7		662.0		.9003	
32.00	.828	156.6		662.4		.9000	
31.85	.637	156.7		662.2		.9001	
31.70	.427	156.7		661.9		.8998	
31.53	.200	156.6		651.2		.3838	

31.38   on foil

Date __15 Feb__   Test No. __45__
Angle of Attack __+4.0__   Side __flat__
Water Temp ____ Room Temp ____ Manometer Tubes ____
Station __2__
Lens distance from Window __on foil__
Initial Pointer Reading __31.12__

Pointer	Distance from Wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.96	11.801	156.7		709.4		.9633	
39.00	10.519	156.6		705.4		.9525	
RF 38.05	9.251	156.8		702.1		.9527	
RF 36.94	7.769	156.8		694.9		.9430	
RF 36.00	6.514	156.8		686.7		.9321	
RF 35.02	5.206	156.9		677.3		.9185	
34.09	3.965	156.9		667.8		.9056	
32.97	2.470	157.0		649.1		.8777	
32.00	1.175	157.0		630.0		.8538	
31.88	1.015	157.0		627.4		.8503	
31.70	.774	157.0		622.8		.8441	
31.51	.521	157.3		623.7		.8437	
31.39	.366	157.2		620.7		.8404	
31.21	.120	157.0		605.8		.8210	
31.10	-.023						on Foil

Date __15 Feb__   Test No. __46__

Angle of Attack __-4.0__   Side __flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____1_____

Lens distance from Window __on foil__

Initial Pointer Reading __31.04__

Pointer	Distance from Wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.97	11.921	157.2		713.1		.9646	
39.00	10.626	157.3		708.2		.9583	
38.04	9.344	157.4		704.2		.9522	
36.93	7.863	157.4		677.2		.9452	
36.00	6.621	157.5		693.2		.9365	
35.01	5.300	157.4		677.2		.9236	
34.09	4.071	157.3		671.0		.9077	
33.12	2.777	157.3		649.4		.3784	
32.12	1.533	157.2		609.8		.8254	
32.00	1.282	157.2		601.1		.8136	
31.86	1.095	157.0		529.6		.7791	
31.70	.881	157.1		522.3		.7233	
31.53	.654	157.2		557.1		.7563	
31.37	.441	157.1		541.7		.7340	
31.21	.227	157.0		527.4		.7175	
31.05	.013	157.0		516.2		.6776	
32.57	2.042	157.4		622.7		.8507	

Date __15 Feb__   Test No. __47__

Angle of Attack __+4.0__ Side __Flat__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __4 (repeat)__

Lens distance from Window __on foil__

Initial Pointer Reading __31.52__

Pointer	Distance from Wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point
40.00	11.320	156.1		707.3		.9655
39.00	9.985	157.9		704.6		.9617
38.05	8.717	157.3		709.2		.9593
36.93	7.222	157.2		705.1		.9544
36.00	5.730	157.3		700.8		.9420
RF 35.02	4.672	157.6		699.8		.9448
34.09	3.431	157.8		697.7		.9408
33.29	2.363	157.9		694.0		.9352
32.32	1.062	158.2		692.6		.9315
32.18	.781	158.1		691.9		.9312
32.00	.641	158.3		692.1		.9303
31.86	.454	158.2		691.0		.9228
31.70	.240	157.6		684.7		.9186
31.53	.013	153.6		571.1		.7863

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Date ___16 Feb___   Test No. __48__

     Angle of Attack __+4.0__ Side __convex__

Water Temp ___ Room Temp ___ Manometer Tubes ___

     Station ___LE___ (Just ahead of foil)

Lens distance from Window ___on foil___

Initial Pointer Reading ___30.59___

Pointer	Distance from Wall	Manometer RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point
40.01	12.575	156.8		825.6		1.1244
39.00	11.227	157.2		830.3		1.1238
38.04	9.945	157.2		830.0		1.1234
36.93	8.463	157.1		830.4		1.1247
36.00	7.222	157.4		828.3		1.1205
35.01	5.900	157.7		827.2		1.1161
34.09	4.672	157.6		820.3		1.1075
32.96	3.164	157.5		808.0		1.0916
32.00	1.882	157.5		791.4		1.0692
31.85	1.632	157.5		787.7		1.0642
31.70	1.482	157.6		784.3		1.0589
31.52	1.241	157.6		772.1		1.0505
31.33	1.055	157.5		770.3		1.0407
31.20	.814	157.6		760.6		1.0269
31.05	.614	157.7		747.1		1.0107
30.90	.414	157.7		724.8		.9773
30.73	.137	157.8		606.8		.8108

P.F (marked at row 36.00)

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Date __16 Feb__ Test No. __42__

Angle of Attack __-4.0__ Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____ LE (Just ahead)

Lens distance from Window __on foil__

Initial Pointer Reading __30.59__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
30.57	-.013	157.9		479.5		.6461	
30.41	-.240	157.8		526.2		.7095	
30.26	-.441	157.9		564.2		.7603	

Date __16 Feb__   Test No. __49__

Angle of Attack __+4.0__ Side __convex__

Water Temp ____ Room Temp ____ Manometter Tubes ____

Station ____ TE (Just aft) ____

Lens distance from Window __all fail__

Initial Pointer Reading __39.20__

Pointer	Distance from wall foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.98	14.390	157.6		828.6		1.1187	
39.00	13.082	157.5		827.4		1.1173	
38.03	11.787	157.6		827.2		1.1168	
36.93	10.319	157.6		824.1		1.1126	
36.00	9.077	157.7		818.8		1.1043	
35.01	7.756	157.0		814.3		1.0966	
34.08	6.514	158.0		804.4		1.0833	
32.78	5.046	157.9		790.9		1.0658	
32.00	3.732	157.9		777.3		1.0474	
31.05	2.470	157.9		757.7		1.0210	
30.59	1.856	157.8		742.0		1.0036	
30.10	1.201	158.0		724.2		.7751	↓
2?.??						2.????	First Shicker
?.???		156.0				2.????	error
29.93	.774	156.7		626.1		.3762	↑
27.??	.801	156.3		463.6		.6271	
27.63	.574	157.0		379.3		.3735	↓

Date _13 Feb_   Test No. _49A_

     Angle of Attack _+4.0_   Side _convex_

Water Temp ____ Room Temp ____ Manometer Tubes ____

     Station _____ TE _____

Lens distance from Window _on Foil_

Initial Pointer Reading _30.50_

Pointer	Distance from ~~Wall~~ Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
31.56	1.415	153.9		009.1		.0122	
would signal would a false	_rise little at one rate th. not die only_	_can't at_	_I volt but this signal amplified_	_this appeared to use a weak output, and_	_the drop that may have_	_inter it al been_	_a little_
31.35	_feet_	_can't_	_not any signal other than I volt_				
freq. shift							

Date _17 Feb_   Test No. _50_

     Angle of Attack _+4.0_ Side _CONVEX_

Water Temp ___ Room Temp ___ Manometer Tubes ___

     Station _____5_____

Lens distance from Window _on foil_

Initial Pointer Reading _32.28_

	Pointer	Distance from Wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	39.98	10.279	157.0		823.5		1.1898	
	39.00	8.971	156.2		283.6		1.2037	
	38.04	7.629	156.5		896.9		1.2194	
	37.10	6.434	156.4		906.6		1.2334	
	36.30	5.366	156.4		920.0		1.2516	
	35.35	4.093	156.5		936.5		1.2733	
R.F	34.40	2.830	156.6		960.6		1.3052	
	33.44	1.548	156.7		936.0		1.3339	
	33.30	1.362	156.9		990.1		1.3427	
	33.12	1.121	156.9		975.4		1.3499	
	32.97	.921	156.9		999.7		1.3557	
	32.80	.694	157.0		1000.2		1.3555	
x.F	32.64	.481	156.9		996.1		1.3545	a weak signal
	32.64	.481	157.2		1000.1		1.3550	strong signal
	32.50	.294	157.2		912.7		1.2354	
	32.31	.040						

Date __17 Feb__   Test No. __I__

        Angle of Attack __+4.0__   Side __CONVEX__

Water Temp ____ Room Temp ____ Manometer Tubes ____

         Station ____4____

Lens distance from Window __on foil__

Initial Pointer Reading __32.51__

Pointer	Distance from Wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.97	9.958	157.7		885.8		1.1861	
39.00	8.664	158.9		896.1		1.1999	
38.04	7.382	158.6		977.6		1.3129	
37.10	6.127	158.9		984.5		1.3183	
36.13	4.832	158.7		987.2		1.3236	
35.20	3.591	158.6		989.2		1.3272	
34.22	2.283	158.7		994.0		1.3327	
33.45	1.255	158.7		997.9		1.3379	
33.29	1.041	158.6		999.9		1.3415	
33.11	.801	158.6		1000.7		1.3425	
32.98	.627	158.7		1000.5		1.3414	
32.72	.287	158.8		1000.2		1.3402	
32.65	.187	158.8		999.9		1.3395	
32.50	-.013	158.9		998.9		1.3334	
from	32.74 on	towards	foil	pour against which looked			
good data	to	etc.	corrected	to 1mm	reg slight	signal	
and strong							

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Date __17 Feb__   Test No. __52__

Angle of Attack __-4.0__   Side __Convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____6____

Lens distance from Window __on foil__

Initial Pointer Reading __32.40__

Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	10.145	158.3		877.9		1.1827	
39.00	8.810	158.5		886.4		1.1899	
38.04	7.527	158.6		891.3		1.1958	
37.10	6.274	158.6		905.6		1.2150	
36.13	4.979	158.5		938.6		1.2600	
35.20	3.738	158.6		977.1		1.3404	?
34.55	2.370	158.7		999.8		1.3405	?
33.60	1.602	158.7		961.4		1.2890	
34.01	2.149	158.6		946.8		1.2702	
34.50	2.803	157.2	? flow not up ? ro speed	929.2		1.2577	verified checked signal
35.45	4.071	158.9		924.2		1.2376	
36.40	5.340	158.7		940.7		1.2615	
33.45	1.402	158.5		957.4		1.2866	
34.35	2.603	153.6		940.7		1.2620	
33.29	1.135	158.6		966.6		1.2968	
33.11	.948	157.6		976.7		1.3106	
32.76	.748	158.5		985.2		1.3236	

Date __17 Feb__   Test No. __52__

Angle of Attack __+4.0__   Side __CONVEX__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____6_____

Lens distance from Window ____on foil____

Initial Pointer Reading _____32.40_____

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
32.80	.534	153.5		939.5		1.3383	
Raw signal becomes dominated by free shifter signal							
but continues to track well other signal out into							
tracker. I don't trust results either and including							
here. Perhaps so much turbulence signal too weak							
but from shifter signal much louder than real							
signal.							
32.64	.320	153.6		996.3		1.3366	
32.50	.133	153.5		992.1		1.3399	
32.33	-.107	153.5		1000.4		1.3430	
Nearing edge of foil but still tracks about 1100 volts							
32.55	.200	153.0		756.7		1.2934	True signal
32.70	.400	153.6		764.0		1.3015	True signal
32.40	Raw signal difference with real results and shifter						
32.80	.534	153.6		968.1		1.2982	
32.90	.667	153.6		765.2		1.2949	
32.97	.921	153.6		762.5		1.2914	Checked by

Vel = 0

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Date __15 Feb__ Test No. __53__

Angle of Attack __+4.0__ Side __convex__

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station __7__

Lens distance from Window __on foil__

Initial Pointer Reading __31.85__

	Pointer	Distance from ~~Wall~~ Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	40.00	10.946	157.9		849.1		1.1442	
RF	39.00	9.611	157.5		851.0		1.1497	
RF	38.04	8.330	157.5		853.0		1.1524	
RF	37.10	7.075	157.4		856.4		1.1577	
RF	36.99	5.593	157.3		857.8	·	1.1603	
	36.01	4.285	157.3		859.5	·	1.1626	
RF	34.08	3.044	157.3		261.6		1.1655	
RF	33.11	1.749	157.5		863.6		1.1667	
	32.42	.828	157.5		865.3		1.1690	
	32.28	.641	158.0		863.3		1.1700	
	32.17	.494	153.1		867.7		1.1707	
RF	32.00	.267	157.4		874.0		1.1230	
RF	31.85	.067	157.7		603.3		.8039	lower signal
RF	31.70							in foil

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Date __12 Feb__   Test No. __54__
         Angle of Attack __+4.0__ Side __CONVEX__
Water Temp ____ Room Temp ____ Manometer Tubes ____
         Station _____2_____
Lens' distance from Window __on foil__
Initial Pointer Reading _____31.30_____

Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	11.614	157.3		846.1		1.1201	
39.00	10.279	159.2		846.6		1.1315	
38.04	8.997	159.2		842.1		1.1235	
RF 37.10	7.742	159.3		844.9		1.1235	
35.99	6.261	159.4		843.5		1.1260	
RF 35.00	4.939	157.3		838.4		1.1199	
34.09	3.724	159.3		830.3		1.1090	
33.11	2.416	159.4		820.4		1.0951	
RF 32.18	1.175	159.6		804.9		1.0731	
32.60	1.735	159.6		815.0		1.0866	
31.95	.868	159.6		797.7		1.0642	
RF 31.84	.721	159.7		796.2		1.0616	
31.70	.534	159.6		787.3		1.0533	
RF 31.52	.294	159.3		712.0		.9433	
31.37	.107	159.3		465.5		.6194	
31.33							

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Date ___18 Feb___   Test No. ~~##~~ 55

Angle of Attack __+4.0__   Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ___9___

Lens distance from Window __on foil__

Initial Pointer Reading ___~~30.17~~ 30.24___

Pointer	Distance from ~~Wall~~ Foil	~~Manometer~~ RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	*Beam split at edge of... distal t!...*	*t... edge of... t c..of...*	*t... t.... l......*	*... mtr...*	*......*	*Pattern ?*	*.11/*
32.31	1.962	160.2		773.7		1.0245	
3F 33.39	3.404	160.0		200.6		1.0447	
34.65	5.036	159.9		217.2		1.0374	
36.09	7.002	160.0		231.9		1.1063	
3F 37.20	7.470	160.2		837.3		1.1154	
38.30	9.953	160.1		843.3		1.1208	
39.00	10.893	160.1		842.0		1.1190	
39.90	12.094	160.1		844.7		1.1226	
RF 31.70	1.148	160.0		761.7		1.0130	
RF 31.52	.908	160.0		752.1	.	1.0032	
31.39	.734	160.2		745.3		.9373	
31.21	.494	160.3		635.2		.8307	
2.6 31.06	.294					*1.....*	*... ...*
30.90	.030	160.1		265.2	.3531	*1. ..*	*vel ....*
final	*d.t₂*	*...l.t*	*f..t ₂*	*h.t ?*	*.. len..*	*...*	*...*
Path	*... ...*	*t .. .*	*...wl/..t*	*...*	*...*	*...*	*... ...*

(*... ....*)

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Date _12 Feb_   Test No. _56_

Angle of Attack _+4.0_   Side _Convex_

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station _____3_____

Lens distance from Window ___ in foil ___

Initial Pointer Reading _____ 32.17 _____ (32.18)

Pointer	Distance from Worn Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	10.439	157.0		269.2		1.1584	
39.00	9.104	157.0		767.1		1.1677	
38.04	7.823	158.0		272.0		1.1743	
39.94	10.359	157.9		770.1		1.1769	
35.99	5.036	157.0		772.1		1.2014	
35.02	3.791	157.3		747.4		1.743	
34.09	2.550	157.4		717.3		1.2349	
33.11	1.241	158.6		737.6		1.2579	
32.96	1.041	158.6		741.3		1.2637	
32.70	.828	157.9		745.5		1.2661	
32.64	.614	158.7		747.7		1.2736	
32.49	.414	157.7		755.9		1.2316	
33.31	.174	158.0		757.7		1.2734	
32.17	.000	158.7		761.0		1.2169	
32.00							

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Date _18 Feb_ Test No. _57_

Angle of Attack _+4.0_ Side _convex_

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _2_

Lens distance from Window _on foil_

Initial Pointer Reading _31.50_

Pointer	Distance from Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.01	11.360	153.8		253.6		1.1437	
39.00	10.012	153.9		255.5		1.1456	
38.03	8.717	158.9		257.0		1.1503	
36.92	7.235	159.0		262.1		1.1550	
35.80	5.740	158.7		267.0		1.1610	
34.70	4.272	159.1		273.0		1.1675	
33.60	2.803	159.2		277.7		1.1734	
32.50	1.335	159.2		887.7		1.1864	
32.31	1.081	159.1		279.7		1.1899	
32.18	.908	159.2		291.8		1.1919	
32.01	.681	159.2		894.9		1.1961	
31.85	.467	159.3		296.4		1.1773	
31.70	.267	159.4		201.0		1.2027	
31.51	.013	159.4		200.1		1.2216	
31.37						on foil	

KF (note beside row 34.70)

Date _12 Feb_   Test No. _52_

Angle of Attack _+4.7_   Side _CONVEX_

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____1_____

Lens distance from Window _on foil_

Initial Pointer Reading _31.16_

	Pointer	Distance from wall Foil	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
	39.98	11.774	159.6		243.0		1.1305	
	39.00	10.466	159.8		849.4		1.1310	
RF	32.03	9.171	159.5		247.0		1.1326	
	36.92	7.637	159.6		250.1		1.1333	
	36.00	6.461	159.6		843.4		1.1311	
	34.97	5.036	159.6		846.2		1.1281	
	34.02	3.373	159.5		842.5		1.1239	
XF	33.11	2.603	157.6		237.7		1.1168	
	32.17	1.343	159.5		233.6		1.1120	
	32.00	1.121	159.5		233.3		1.1116	
	31.84	.702	159.6		231.0		1.1092	
	31.70	.721	157.7		234.7		1.1124	
	31.52	.431	157.7		236.5		1.1145	
	31.33	.274	157.7		237.3		1.1156	
	31.20	.053	159.7		342.4		1.1224	
	31.04						IN foil	

Date _13 Feb_   Test No. _59_

    Angle of Attack _−4.0_   Side _convex_

Water Temp ___ Room Temp ___ Manometer Tubes ___

    Station _TE_

Lens distance from Window _on foil_

Initial Pointer Reading _21.76_

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.92	10.973	157.1		207.6		1.0918	
37.00	9.665	157.1		207.5		1.0917	
38.04	8.382	157.1		206.7		1.0906	
37.10	7.123	157.0		205.5		1.0877	
36.00	5.660	157.0		202.4		1.0855	
35.02	4.352	157.3		797.0		1.0761	
34.09	3.110	157.3		786.2		1.0616	
33.12	1.815	157.5		767.4		1.0376	
32.50	.935	157.6		742.7		1.0073	
32.32	.718	157.6		732.4		.9738	
32.17	.547	157.8		732.0		.9352	
32.00	.332	157.7		715.6		.9638	
31.86	.123	157.3		635.2		.8422	
31.70	−.010	152.7		547.3	⎫ IN		Wall Effects
31.51	−.324	157.6		374.5	⎭ Foil		"

Date 17 Feb   Test No. 62

Angle of Attack   -4.0   Side convex

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____ 9 _____

Lens distance from Window ___ 20 fo.1 ___

Initial Pointer Reading ___ 32.00 ___

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	10.679	158.4		210.6		1.0869	
39.00	9.344	158.6		214.1		1.0902	
38.04	8.063	158.8		215.3		1.0904	
37.10	6.707	159.0		216.2		1.0903	
35.98	5.713	159.4		816.6		1.0801	
35.00	4.005	157.8		203.5		1.0815	
34.08	2.777	157.7		773.1		1.0742	
33.11	1.482	157.0		734.5		1.0546	
32.63	.741	157.2		772.3		1.0436	
32.50	.16?	155.3		776.6		1.0420	
32.22							
32.17							
32.09							
32.25							

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Date __17 Feb__   Test No. __61__

Angle of Attack __-4.0__   Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station ____3____

Lens distance from Window __on foil__

Initial Pointer Reading ____32.40____

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.98	10.119	153.7		822.7		1.1010	
39.00	3.310	153.7		224.3		1.1032	
38.04	7.529	153.7		827.3		1.1072	
37.10	6.274	153.7		831.0		1.1121	
35.99	4.792	153.6		833.0		1.1155	
35.01	3.404	153.8		836.3		1.1135	
34.08	2.243	152.6		833.7		1.1232	
33.43	1.375	152.7		840.6		1.1250	
33.29	1.183	158.5		841.4		1.1275	
33.11	.943	152.5		849.1		1.1378	
32.96	.748	153.7		847.4		1.1314	
32.80	.534	57.6		853.5		1.1430	
32.64	.320	152.7		846.0		1.1222	
32.50	.133	152.7		874.3		1.1948	work & acoustic
32.32							on foil

2F (marking at row 33.43)

Date __20 Feb__   Test No. __62__

       Angle of Attack __-4.0__   Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

       Station ____7____

Lens distance from Window __on foil__

Initial Pointer Reading ____33.49____

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.98	9.998	158.6		837.1		1.1076	
39.00	8.690	158.9		832.6		1.1129	
38.02	7.332	159.1		839.7		1.1210	
37.09	6.141	158.2		845.3		1.1306	
35.79	4.622	159.2		858.3	·	1.1451	
35.01	3.364	159.0		873.1		1.1663	
34.07	2.109	158.4		871.7		1.1956	
33.11	.828	158.8		702.6		1.2072	
32.76	.627	159.0		705.6		1.2097	
32.30	.414	157.3		911.7		1.2155	
32.63	.187	159.1		712.3		1.2179	
32.50					·		on foil
				·			

RF (marked at left of row 33.11)

Date __20 Feb__   Test No. __63__

Angle of Attack __-4.0__ Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __6__

Lens distance from Window __on foil__

Initial Pointer Reading __32.49__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.99	10.012	153.4		731.8		1.1153	
39.00	7.690	153.6		740.0		1.1249	
38.03	7.375	153.8		747.9		1.1340	
37.09	6.141	153.9		759.3		1.1436	
35.99	4.672	153.4		870.7		1.1675	
35.01	3.364	153.2		790.7		1.1958	
34.08	2.123	153.2		914.3		1.2232	
33.11	.827	153.2		932.8		1.2523	
33.52	1.375	153.2		920.8		1.2362	
32.96	.627	153.2		936.7		1.2576	
32.30	.414	153.1		943.2		1.2671	
32.64	.200	153.1		747.9		1.2734	
32.50	.013	153.1		933.3		1.2605	
32.34						foil	

2F

Date _20 Feb_ Test No. _64_

Angle of Attack _-4.0_ Side _convex_

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _5_

Lens distance from Window _on Foil_

Initial Pointer Reading _33.76_

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	7.665	158.2		829.5		1.1136	
39.00	7.730	158.3		836.8		1.1237	
38.02	7.022	158.2		842.4		1.1323	
37.10	5.793	158.1		853.2		1.1462	
35.98	4.298	157.2		870.2		1.1633	
34.87	2.817	158.1		884.1		1.1877	
33.75	1.322	158.1		911.0		1.2238	
33.60	1.121	158.1		913.7		1.2275	
33.42	.821	158.1		918.0		1.2332	
33.29	.708	153.0		922.2		1.2397	
33.11	.467	157.9		925.7		1.2454	
32.97	.330	158.2		933.3		1.2522	
32.20							2.1

Date ___20 Feb___   Test No. __165__

    • Angle of Attack ___-4.0___ Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

      Station ___4___

Lens distance from Window ___on foil___

Initial Pointer Reading ___32.25___

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.99	10.332	152.5		814.1		1.0909	
39.00	9.011	152.7		820.6		1.0922	
38.03	7.716	152.6		822.9		1.1020	
36.92	6.234	152.6		829.0		1.1102	
35.80	4.739	152.6		839.5		1.1242	
RF 34.70	3.271	152.7		845.4		1.1314	
33.60	1.802	152.6		857.7		1.1436	
33.42	1.563	152.7		861.6		1.1531	
33.29	1.333	152.6		861.0		1.1530	
33.11	1.148	152.6		864.2		1.1573	
32.76	.943	152.6		866.1		1.1579	
32.89	.734	152.6		867.6		1.1645	
32.65	.534	152.6		872.1		1.1677	
32.49	.320	152.7		876.7		1.1732	
32.32	.073	152.7		872.0		1.1673	
32.16							.14

Date __20 Feb__   Test No. __66__

Angle of Attack __-4.0__ Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __3__

Lens distance from Window __on foil__

Initial Pointer Reading __31.51__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point
40.00	11.333	153.7		794.1		1.0622
39.00	9.993	153.7		792.1		1.0614
38.02	8.670	153.6		791.1		1.0594
36.92	7.222	153.6		787.6		1.0547
35.81	5.740	153.5		785.4		1.0524
34.70	4.253	153.7		779.4		1.0421
33.60	2.790	153.5		773.3		1.0362
32.49	1.303	153.7		764.7		1.0274
32.31	1.063	153.7		764.9		1.0237
32.17	.821	153.7		763.3		1.0215
32.00	.654	153.7		761.6		1.0193
31.84	.441	153.6		761.0		1.0191
31.69	.240	153.8		760.9		1.0177
31.52	.013	153.8		757.3		1.0129
31.20						IN foil

RF (notation next to row 32.49)

Date __20 Feb__   Test No. __67__

Angle of Attack __-4.0__   Side __convex__

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station __2__

Lens distance from Window __on foil__

Initial Pointer Reading __31.02__

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
39.98	11.961	158.4		779.1		1.0447	
39.00	10.453	158.4		778.1		1.0433	
37.89	9.171	158.4		771.3		1.0342	
36.91	7.263	158.4		764.0		1.0244	
35.90	6.514	158.5		755.3		1.0121	
35.01	5.326	158.6		744.7		.9975	
34.06	4.053	158.6		727.3		.9740	
33.11	2.770	158.6		704.1		.9429	
32.00	1.303	158.7		665.3		.8904	
31.85	1.103	158.8		661.7		.8850	
31.70	.908	158.6		653.7		.8754	
31.51	.654	158.6		642.7		.8687	
31.39	.474	158.5		641.7		.7577	
31.20	.240	153.6		633.0		.8477	
31.04	.027	153.6		625.5		.8416	
30.20	-.274						$\frac{1^N}{62.1}$

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Date _20 Feb_ Test No. _68_

Angle of Attack _-4.0_ Side _convex_

Water Temp ___ Room Temp ___ Manometer Tubes ___

Station ___1___

Lens distance from Window ___on foil___

Initial Pointer Reading ___30.30___

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	13.349	158.8		771.2		1.0315	
39.00	12.014	158.4		764.3		1.0248	
38.02	10.706	156.9		753.6		1.0201	
37.10	7.478	157.4		758.1		1.0101	
36.00	3.009	158.7		741.8		.9928	
35.01	6.638	157.0		728.6		.9733	
34.08	5.446	158.7		707.7		.9474	
33.11	4.152	157.1		681.9		.9103	
32.13	2.343	158.3		636.2		.8507	
32.00	2.670	157.7		630.8		.8442	
31.85	2.470	159.0		621.1		.8297	
31.16	1.543	158.2		554.1		.7439	
31.56	2.032	158.5		593.4		.7938	
31.05	1.462	158.5		542.5		.7223	
30.90	1.201	158.5		521.2		.6725	
30.73	.974	158.8		497.3		.6660	
30.50	.722	157.7		467.7		.6286	

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Date ___20 Feb___   Test No. ___62___

Angle of Attack ___-4.0___   Side ___Convex___

Water Temp _____ Room Temp _____ Manometer Tubes _____

Station _____1_____

Lens distance from Window _____ on foil _____

Initial Pointer Reading _____ 30.30 _____

Pointer	Distance from Wall	Manometer RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
RF 30.41	com	not get signal. Pattern looks ok, not very					
	bright	or clear, just discernable. On screen					
	have lot	of noise and dominate freq.					
	shift	10142	signal. Recorded and not in				
	foil	(much	more difficult near edge				
	because foil	is thin and white	.7!			
	side	make	it confusing) Tried all tricks				
	moving up	down on foil	tape unnecessary				
	have etc						

Date _20 Feb_   Test No. _69_

Angle of Attack _-4.0_   Side _convex_

Water Temp ____ Room Temp ____ Manometer Tubes ____

Station _____ LE _(Just end)_

Lens distance from Window _on Foil_

Initial Pointer Reading _30.00_

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
40.00	13.249	158.6		771.8		1.0336	
38.93	11.921	158.6		765.7		1.0254	
38.02	10.706	158.6		759.3		1.0162	
37.10	9.478	158.7		752.0		1.0054	
35.98	7.953	158.9		740.3		.9895	
35.01	6.638	158.5		724.1		.9703	
34.07	5.446	158.6		704.5		.9434	
33.11	4.152	158.8		673.8		.9077	
32.00	2.670	158.7		629.5		.8425	
31.04	1.388	158.8		554.3		.7414	
30.87	1.138	158.8		536.1		.7170	
30.72	.961	158.8		514.0		.6875	
30.58	.774	158.7		485.7		.6493	
30.41	.547	158.4		452.7		.6043	
30.25	.354	158.4		406.9		.5443	
30.10	.153	158.5		350.1		.4671	
30.00	.055	158.7		343.6		.4604	
21.82	-.110	158.8		471.1		.6571	
29.79	-.280	158.8		471.7		.7170	

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Date 31 Jan   Test No. A1

Angle of Attack ___0.0___ flat side to laser

Water Temp 23   Room Temp 25   Manometer Tubes 7/4

Station ___Velocity Constant___

Lens distance from Window ___—___

Initial Pointer Reading ___—___

Pointer	Distance from Wall	Manometer	Freestream Velocity ft/sec	Laser	Velocity at Point ft/sec	Non-dimensional velocity at Point	
MANO	Velocity ft/sec	RPM		vel/RPM			
618.9	10.214	161.5		.06336			
616.6	10.197	161.4		.06318			
617.3	10.200	161.4		.06320			
617.2	10.310	161.4		.06326			
617.4	10.203	161.3		.06325			
617.0	10.200	161.4		.06320			
618.4	10.213	161.5		.06323			
617.8	10.207	161.4		.06324			
618.1	10.209	161.5		.06321			
617.6	10.205	161.5		.06319			
615.2	10.215	161.5		.06325			
620.0	10.225	161.5		.06321			
617.1	10.207	161.5		.06321			
619.0	10.217	161.5		.06326			
617.4	10.203	161.6		.06314			

Avg=10.209   Avg=161.46   Avg=.06322
.06323

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Date __2 Feb__   Test No. __A2__

Angle of Attack __-4.0__ __flat__ to laser

Water Temp __32__ Room Temp __75__ Manometer Tubes __7/4__

Station __Velocity Constant__

Lens distance from Window _____

Initial Pointer Reading _____

Pointer	Distance from wall	Diameter	Freestream Velocity = ft/sec	Laser	Velocity at Point ft/sec	Non-dimensional velocity at Point
Plans	Velocity ft/sec	10 sec avg RPM		Vel/RPM		
593.0		158.4		.0631333		
592.2		158.4				
591.8		158.4				
593.0		158.6				
592.3		158.4				
592.1		158.4				
592.3		158.3				
591.9		158.4				
592.8		158.3				
591.9		158.3				
592.2		158.4				
592.1		158.3				
591.6		158.4				
592.1		158.4				
592.7		16.7				

Avg: 512.36   Avg: 158.27464

Vel = 2.3194871

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Date ___6 Feb___   Test No. ___3A___

       Angle of Attack ___+4.0___ Side ___flat___

Water Temp ___77___ Room Temp ___75___ Manometer Tubes ___1/4___

       Station ___Velocity___

Lens distance from Window _____

Initial Pointer Reading _____

Pointer	Distance from Wall	RPM	Freestream Velocity ft/sec	Laser Volts	Velocity at Point ft/sec	Non-dimensional Velocity at Point	
Mano				Avg Mano → 600.78			
				Avg RPM → 159.69332			
598.5		159.4		Avg Vel → 10.0637			
600.3		159.5		Vel/Rpm →	.0630198		
577.1		159.6					
597.8		159.6					
600.2		159.6					
598.0		159.6					
599.3		159.6					
600.4		159.7					
600.7		159.7					
601.3		159.7					
601.2		159.7					
601.7		159.7					
601.5		159.3					
604.7		159.7					
603.0		160.1					

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